MODERN PLASTICS

E. F. LOUGEE, EDITOR • DR. G. M. KLINE, TECHNICAL EDITOR • C. A. BRESKIN, PUBLISHER

AUGUST 1938 VOLUME 15 NUMBER 12

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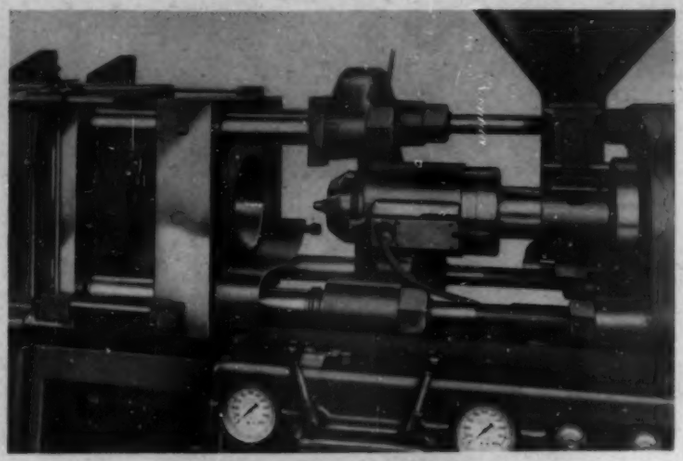
• NEXT MONTH

A comparatively new process for metalizing plastic surfaces will be announced and described in our September issue. Worked out in France, the idea was brought to America last year but only recently was a pilot plant established and the technique perfected. For decorating plastic objects with precious metals, for metalizing plastic dental plates, or for plating conductivity to specified parts of plastic insulation, the process holds promise in decorative, scientific and technical application.

REED-PRENTICE INDUCTION HEATING (Patent Pending)

(Now standard equipment—No. 10-A 2 oz. and 10-B —10-C & 10-D 6 oz. machines)



Advantages:

(1) Absolute uniform heating of material

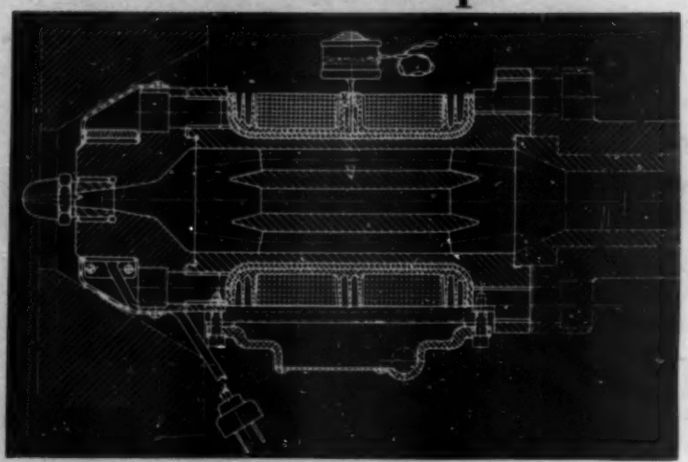
(2) More accurate temperature control of material

(3) Quicker heating and better maintenance of temperature

(4) Longer Life of heating cylinder.

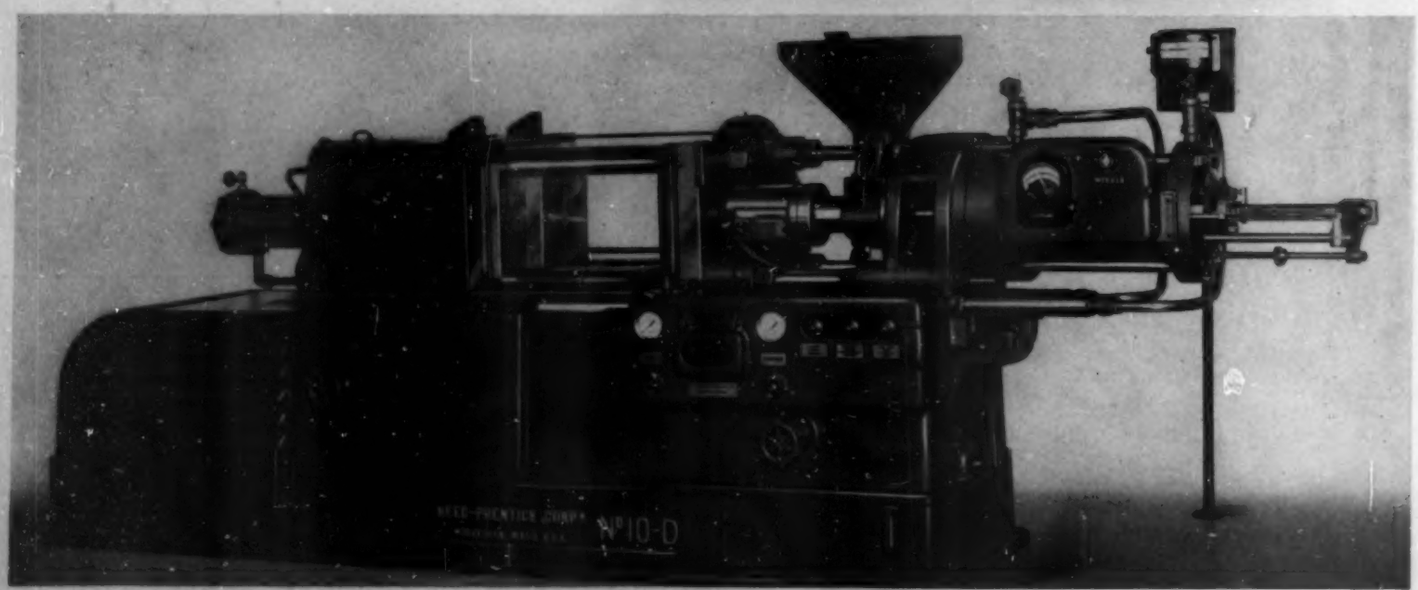
This new and improved method of heating is now available for all previous #10 and #10-A 2 oz. Reed-Prentice Automatic Plastic Injection Molding Machines. In applying for information give serial number of machines.

the greatest advancement since the development of injection molding



As shown right, cylinder proper serves as a core in an induction coil and is designed to induce the maximum heating effect *in the steel*. Material is forced thru seven holes and every surface of material is subjected to the same temperature. Coils are connected in parallel and series. When starting coils are in parallel which quadruples the heating effect. When within six degrees of set temperature, they are automatically switched to series for maintenance of temperature. A drop of six degrees automatically again drops the coils into parallel and temperature is quickly raised to series maintenance.

Repeated tests have shown this induction heating cylinder will heat several times as fast. Temperature of 400°F has been secured in less than five minutes. In addition, this construction provides absolute uniform heating of material, more accurate temperature control and longer life of heating cylinder.



REED-PRENTICE CORPORATION

WORCESTER, MASS., *Main Office and Works* **75 WEST STREET, NEW YORK OFFICE**

More REED-PRENTICE Plastic Injection Molding Machines are in use than any other make—over 140 machines

Wider fields for slide fasteners—

TODAY, slide fasteners are high style. For now, thanks to *plastics*, they can be made in colors which make them adaptable for many new items. Thus, plastics open a tremendous new market for TALON* fasteners.

Two different Du Pont plastics are used in the manufacture of the various parts of the TALON* plastic fastener. These fasteners are strong and durable, yet extremely light in weight. They have brought new charm and appeal to hundreds of garments and products, and greatly increased their merchandising possibilities.

The color, finish and natural advantages of Du Pont plastics have proved a boon to many different businesses. And their economy and ease of manufacture have frequently helped reduce costs.

People who sell anything bought by women know how vital are color, style and beauty. Thousands of manufacturers have built up sales by styling their products with plastics.

No one plastic can fill all the varied needs of the many different products that are—or can be—made of plastics. Du Pont has therefore developed a group of different plastics, each with special characteristics and advantages. One of these plastics may fit your requirements *exactly*.

Write E. I. du Pont de Nemours & Co., Inc., Plastics Department, Arlington, New Jersey.

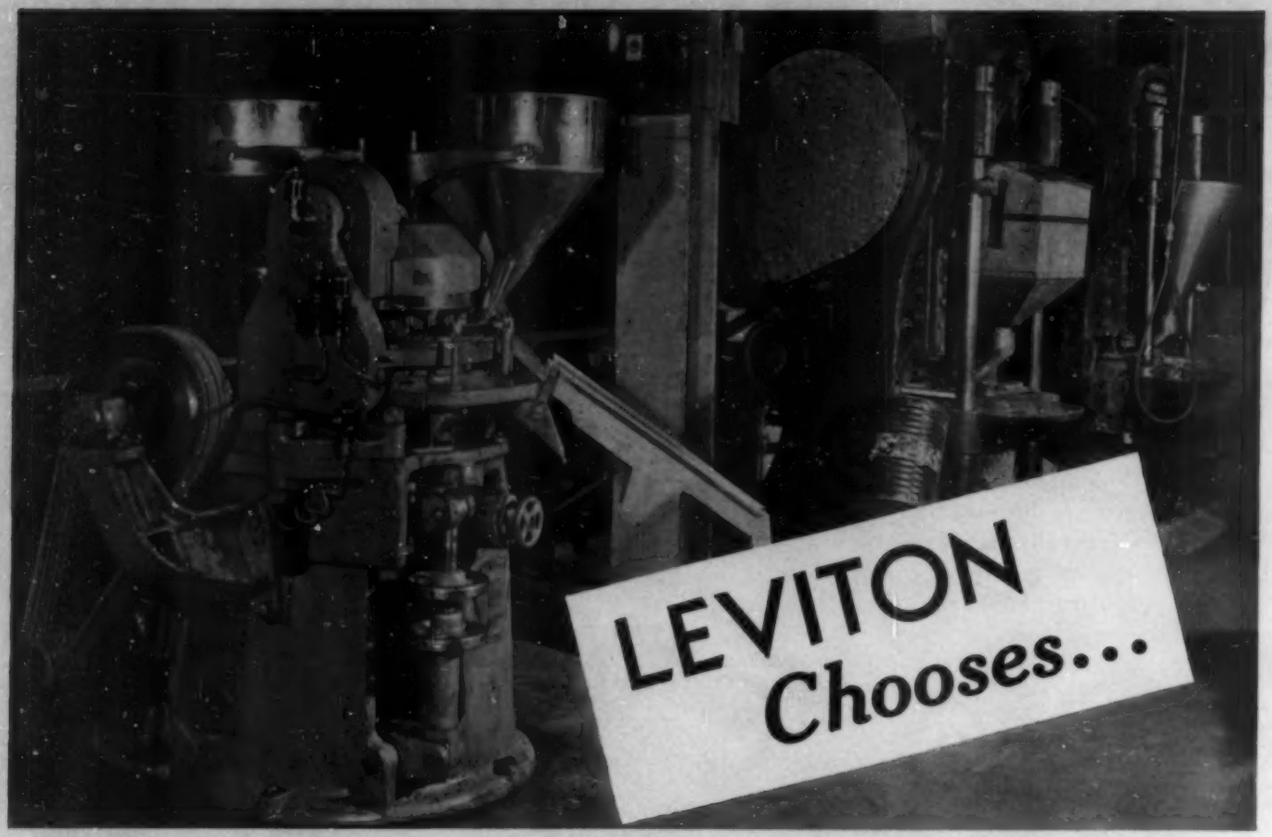
*Reg. U. S. Pat. Off. by Talon, Inc.

AMONG DU PONT'S LINE OF PLASTICS ARE:

"Pyralin" cellulose nitrate plastic; "Plastacele" cellulose acetate plastic; "Lucite" methyl methacrylate resin. These plastics are available in sheets, rods and tubes. For injection and pressure molding, there are: "Plastacele" cellulose acetate molding powder and "Lucite" methyl methacrylate molding powder.

DU PONT

PLASTICS



STOKES PREFORM PRESSES

Leviton Manufacturing Co., Brooklyn, N. Y., manufacturer of electrical equipment, is another of the many leading concerns who prefer Stokes Presses for preforming operations. In this plant the Stokes installation now consists of a DD-2 Rotary and two large Stokes-Standard toggle-type presses. The Rotary makes preforms of $1^{3}/_{16}$" maximum diameter, at 500 to 600 per minute. The Stokes-Standard presses, developing 80 tons pressure, make preforms up to 4" diameter at rates up to 45 or more per minute.

Investigate the advantages and economies of Stokes Presses . . . learn why they are preferred equipment in so many plants . . . see for yourself the rugged simplicity of these machines, how thoroughly and positively Stokes design and construction protect working mechanisms from abrasive materials . . . how effectively the excess pressure release mechanism protects against jamming and breakage . . . how quickly and simply punch changes are made. Write for complete information.

F. J. STOKES MACHINE COMPANY
5934 Tabor Road Olney P. O. Philadelphia, Pa.
Representatives in New York, Chicago, Cincinnati, St. Louis.
Pacific Coast Representative: L. H. Butcher Company, Inc.

F.J.Stokes MOLDING EQUIPMENT FJS Est. 1895

LUMARITH

REG. U.S. PAT. OFF.

Applying its advantages to HOME APPLIANCES

BECAUSE it is always bright, always pleasant in touch and appearance . . . because it is versatile in production, strong, and durable . . . because its color range is virtually unlimited . . . Lumarith has grown more and more popular with manufacturers of home appliances.

An outstanding example is the Lovell Pressure Cleansing Clothes Wringer . . . standard equipment on many of the best known washing machines. To increase its sales appeal, the Lovell Wringer makes effective use of Lumarith's handsome appearance.

Besides beauty and utility in the finished product, Lumarith molding powders offer the molder easy moldability . . . low shrinkage in the mold . . . minimum shrinkage after molding. Lumarith comes also in sheets, rods, tubes, and rolls of continuous length which can be carved, cemented to other materials, die-formed, embossed, laminated, machined, molded, pleated, printed, scored, stitched, stretched, swaged, or even hand-shaped.

For home appliances or any other products in which plastics can be used . . . it will be worth your while to get full information on Lumarith. Write Plastics Division, CELLULOID CORPORATION, 10 E. 40th Street, New York City. Established 1872. Sole Producer of Celluloid and Lumarith. (Trademarks Reg. U. S. Pat. Off.)

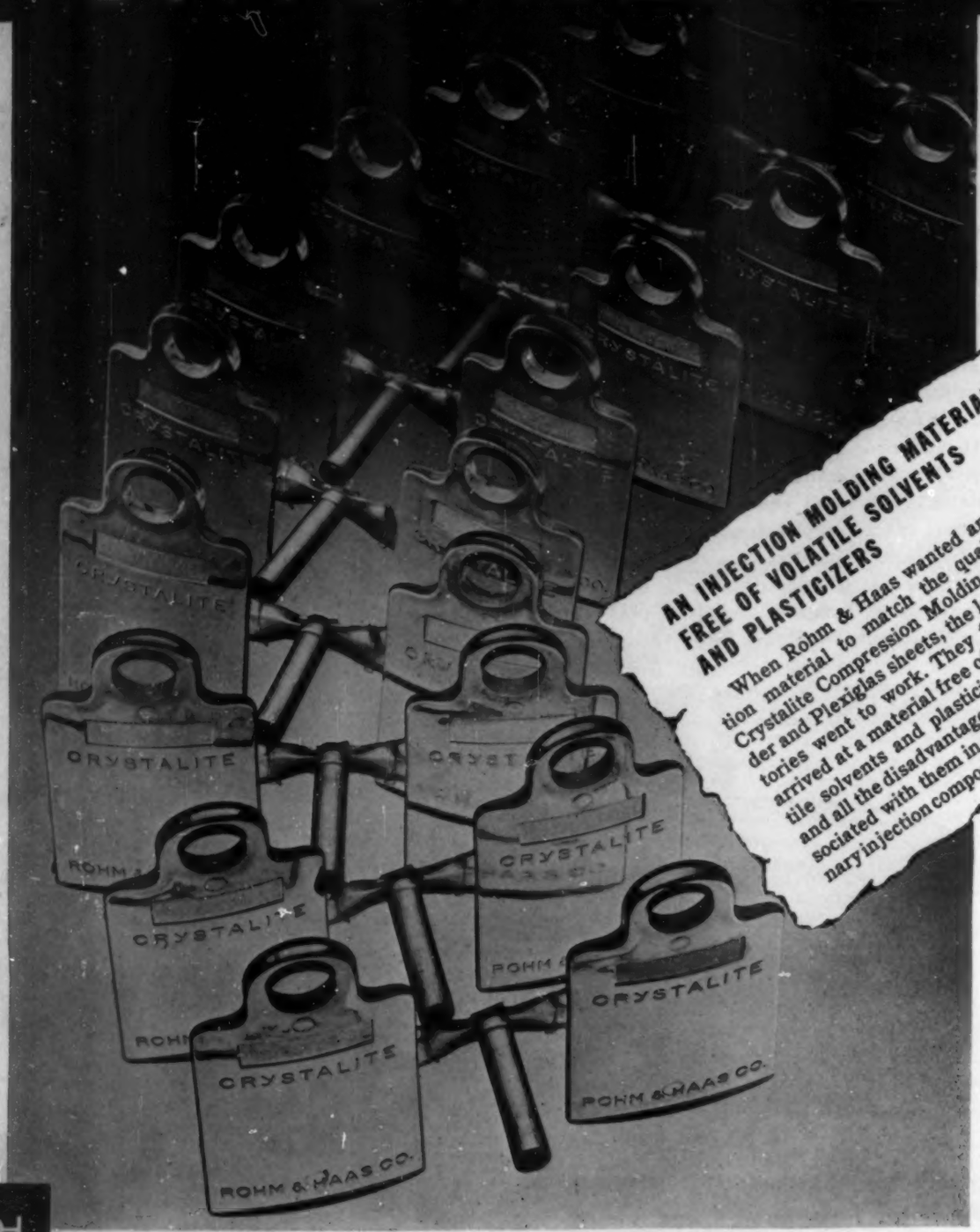
Front and side view of the new 1938 Lovell Wringer. The cap for the pressure indicator is made of Lumarith . . . the new era plastic.

When you think of plastics, think of headquarters— "the Grand-daddy of them all" . . and . .

Get in touch with CELLULOID

. . also Headquarters for Transparent PACKAGING MATERIALS

CRYSTALITE*



AN INJECTION MOLDING MATERIAL FREE OF VOLATILE SOLVENTS AND PLASTICIZERS

When Rohm & Haas wanted an injection material to match the quality of Crystalite Compression Molding Powder and Plexiglas sheets, the laboratories went to work. They finally arrived at a material free of volatile solvents and plasticizers, and all the disadvantages associated with them in ordinary injection compounds.

CRYSTALITE
MOLDING COMPOUNDS

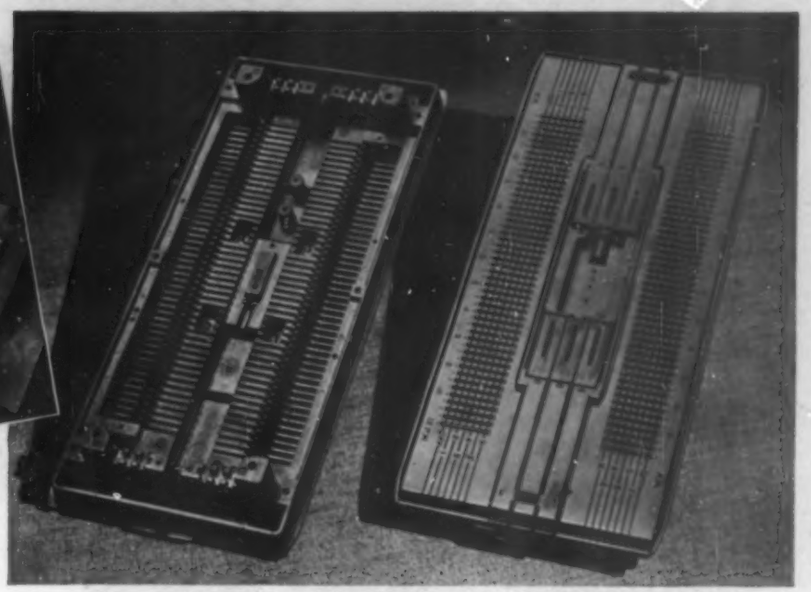
PLEXIGLAS
PLANE AND FORMED SHEETS

*Reg. U. S. Pat. Off.

RÖHM & HAAS COMPANY, INCORPORATED
***222 West Washington Square,* PHILADELPHIA, PA.**

Can You Imagine MAKING THIS PART OUT OF ANYTHING BUT PLASTICS?

The steel mold construction for the preselector panel—an example of true craftsmanship



Front and rear view of the Textolite molded preselector panel

NINETY-FOUR barriers, ninety-six slots, and a variety of bosses, holes, ribs, depressions and studs—that is the Textolite molded preselector panel for the 1939 G-E radio on which you can set up your schedule of programs in advance for a 24-hour period with the selection of five stations.

Think what it would cost to make this panel out of metal or some other material. At the same time think of the savings in simplified assembly because of the combined electrical and mechanical properties of Textolite. Think of the savings in finishing costs—no drilling, plating, or painting.

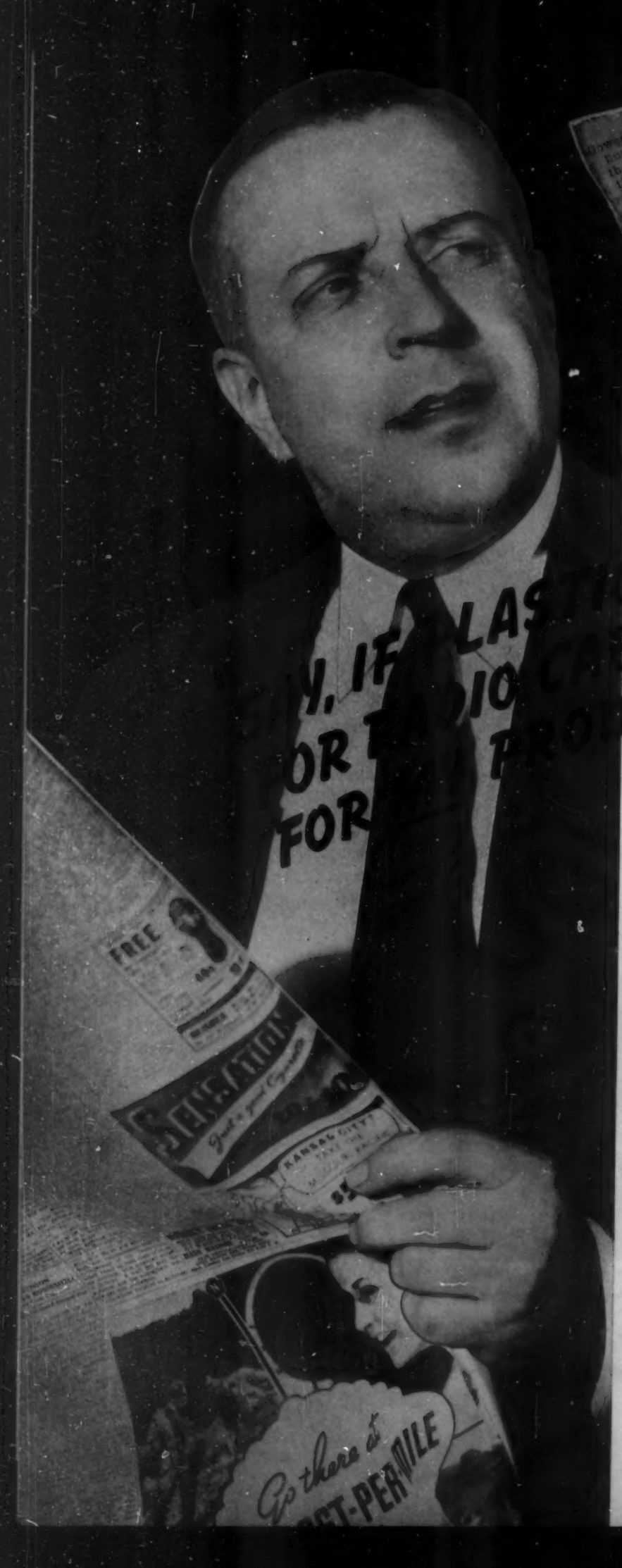
Last, but not least, think of the engineering, designing, and manufacturing facilities required to produce this panel accurately and economically, and you will realize that the General Electric Plastics Department is fully equipped in personnel and machinery to take care of any molding problem. It is parts like this preselector panel, the big Wakefield reflector, the Univex exposure meter, the Wico magneto parts and, the Autobridge boards that make General Electric the most dependable and outstanding molder in the country.

This is how the Textolite molded preselector panel looks when assembled

General Electric is anxious to serve *you* well, too. For complete information, write to Section R8, Plastics Dept., General Electric, 1 Plastics Ave., Pittsfield, Mass.

GENERAL ELECTRIC

PD-83



PLASTIC CABINETS SET MODERN NOTE IN 1939 RADIOS
Leading Manufacturers Use Plastics to Increase Sales of their Products

...Y, IF LAS...CS CAN BE USED FOR ...BINETS, WHY NOT ...UCT?"

WE AGREE, MR. MANUFACTURER! More than that...if you even *suspect* that plastics might be usable in your product, the odds are that they can make a major contribution to your manufacturing methods and sales successes!

Time after time, we have seen it happen. A manufacturer has sensed that there might be some use for plastics in his product...if only to add a touch of beauty. And, once a study of his problem was begun, there were revealed countless ways of adding strength and lightness, along with beauty.

Plastics have a host of features that make them remarkably versatile, and, unless *your* products have already been analyzed in the light of present day applications of plastics, *you can't know what they might mean in your business.*

Just which one of the many available types of plastics will fit your need is difficult to tell until we know your problem. But, whatever your need may be, Monsanto has the answer, because, although not in the fabrication business, we do supply molders with plastics for fabrication, and are constantly working with them toward a higher standard of achievement in the plastics industry.

A letter from you will bring specialized information on the application of plastics in *your* products.

MONSANTO PLASTICS

CELLULOSE ACETATE • CELLULOSE NITRATE • CAST PHENOLICS
Available in sheets, rods, tubes and molding powder form

Monsanto Chemical Company
PLASTICS DIVISION, INDIAN ORCHARD, MASS.

HPM

FIRST
FIRST
FIRST
FIRST

To pioneer injection molding in this country . . . and to prove that injection molding offered the modern molder unlimited opportunities to broaden his scope and improve his business.

To design and build an injection molding press to meet the mass production requirements of business as it is conducted in the United States.

To recognize the need for larger capacities, to meet the ever increasing demand for larger thermo-plastic parts, which resulted in the development of the vertical clamp type of Injection Molding Press with multiple injection units.

To build Injection Molding Presses of 500 tons pressure capacity each, calling for four multiple injection units and providing a total capacity of 32 ounces per shot, for the molding of automotive instrument panels, window frames, steering wheels, grills, reflectors, etc.

For an intelligent analysis of your molding requirements . . . based on a sound and broad knowledge of the subject . . . call in an H-P-M engineer. Write for Bulletin 3803 for the most complete information ever published on injection molding.

THE HYDRAULIC PRESS MFG. COMPANY, MOUNT GILEAD, OHIO, U. S. A.

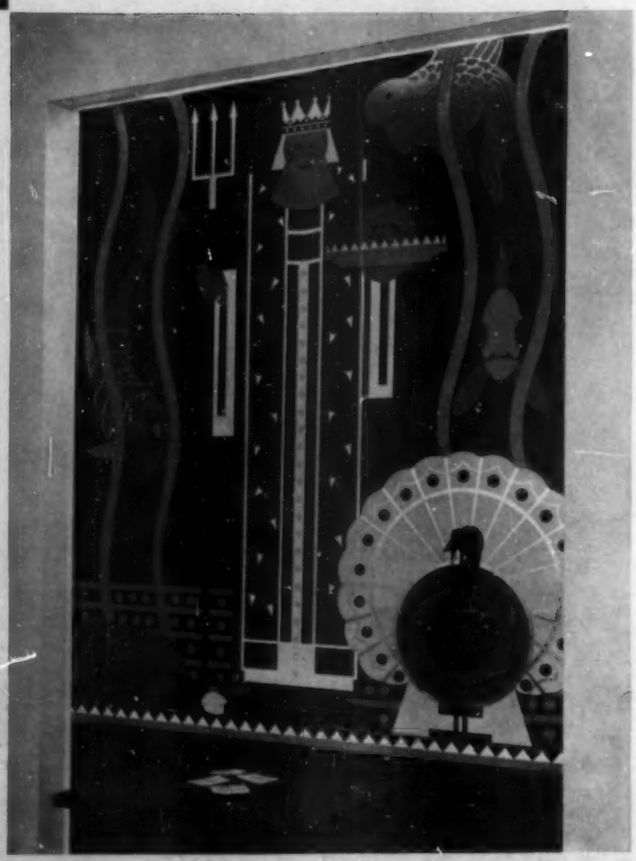
District Offices:
New York, Detroit, Chicago

HPM

Representatives
In Principal Cities

INJECTION MOLDING PRESSES

There is INDIVIDUALITY in FORMICA INLAYS



There is no necessity for sameness or monotony in wall covering installations worked out in Formica. The great variety of colors available and the possibility of working out characteristic decorations by inlaying one color over another, or inlaying metal permits every job to be quite individual. This great flexibility naturally is pleasing to the designer or architect who aims at something different... The material is also thoroughly durable and practical. It is hard and will wear; it is chemically inert and will not be spotted by ordinary liquids and cleaning solutions, and it will not crack or chip.

Let us send you all the facts

THE FORMICA INSULATION COMPANY
4620 Spring Grove Ave., Cincinnati, Ohio

FORMICA

FOR BUILDING PURPOSES

We all start small. That's no criticism.

But where we go from there . . . whether we stay unimportant or go places . . . that's the test.

Some get so big they get unwieldy. Others don't grow at all.
Boonton has grown in a closely integrated way that permits us to offer every advantage of modern and complete equipment . . . coupled with a personalized and conscientious service.

We're big enough to employ *top flight* men, big enough to hit *top efficiency*, big enough to have the reserve capacity to take every "rush" order in peak stride. Yet we're small enough to avoid red-tape-worm, small enough to keep our experts in *first hand* contact with client's problems.

We're compact, competent . . . and hitting on all cylinders.

"A Ready Reference for Plastics." Written for the layman, this unique handbook explains the uses and characteristics of plastics in plain, non-technical language. Write for FREE copy.

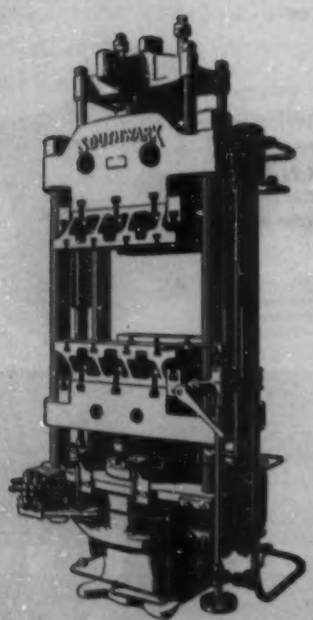
BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-0991

N. Y. Office 30 Church St. COrtlandt 7-7971

Cabinets in the modern manner



Plastics . . . Molded on Southwark Presses . . . by Northern Industrial Chemical Co.

"We are well pleased with our Baldwin-Southwark equipment, which evidences itself in the great many re-orders we have placed for these presses."

This is what Northern Industrial Chemical Co. thinks about Southwark molding presses.

The cabinets shown, for Philco (ivory Beetle) and American Bosch (Bakelite) are excellent examples of what design engineers can accomplish with plastic materials and modern molding equipment.

For modern equipment . . . for the economies it makes possible . . . and for the many operating advantages it offers and the high quality moldings it produces . . . consult with Southwark engineers.

BALDWIN-SOUTHWARK CORPORATION

Southwark Division, Philadelphia, Pa.

Pacific Coast Representative: THE PELTON WATER WHEEL CO., San Francisco

Consultants on Molding Equipment, Burroughs Engineering Company, Newark, N. J.

SOUTHWARK PRESSES

WHERE

are cellulose plastics headed?

These Hercules raw materials hold some of the answers

Rapid progress in making and molding plastics has required new cellulose derivatives and improvements in old ones. We have met these demands as they arose, and have frequently been prepared for them in advance. This has been possible because of our position as large producers of cellulose derivatives, and because of our extensive research in cellulose chemistry.

Wherever plastics are headed, we expect—by working closely with the industry—to have cellulose materials that will facilitate future advances.

1913 • SERVING INDUSTRY • 1938
25th Anniversary Year

CELLULOSE PRODUCTS DEPARTMENT

HERCULES POWDER COMPANY
Incorporated
916 MARKET STREET
WILMINGTON, DELAWARE

DDD-3

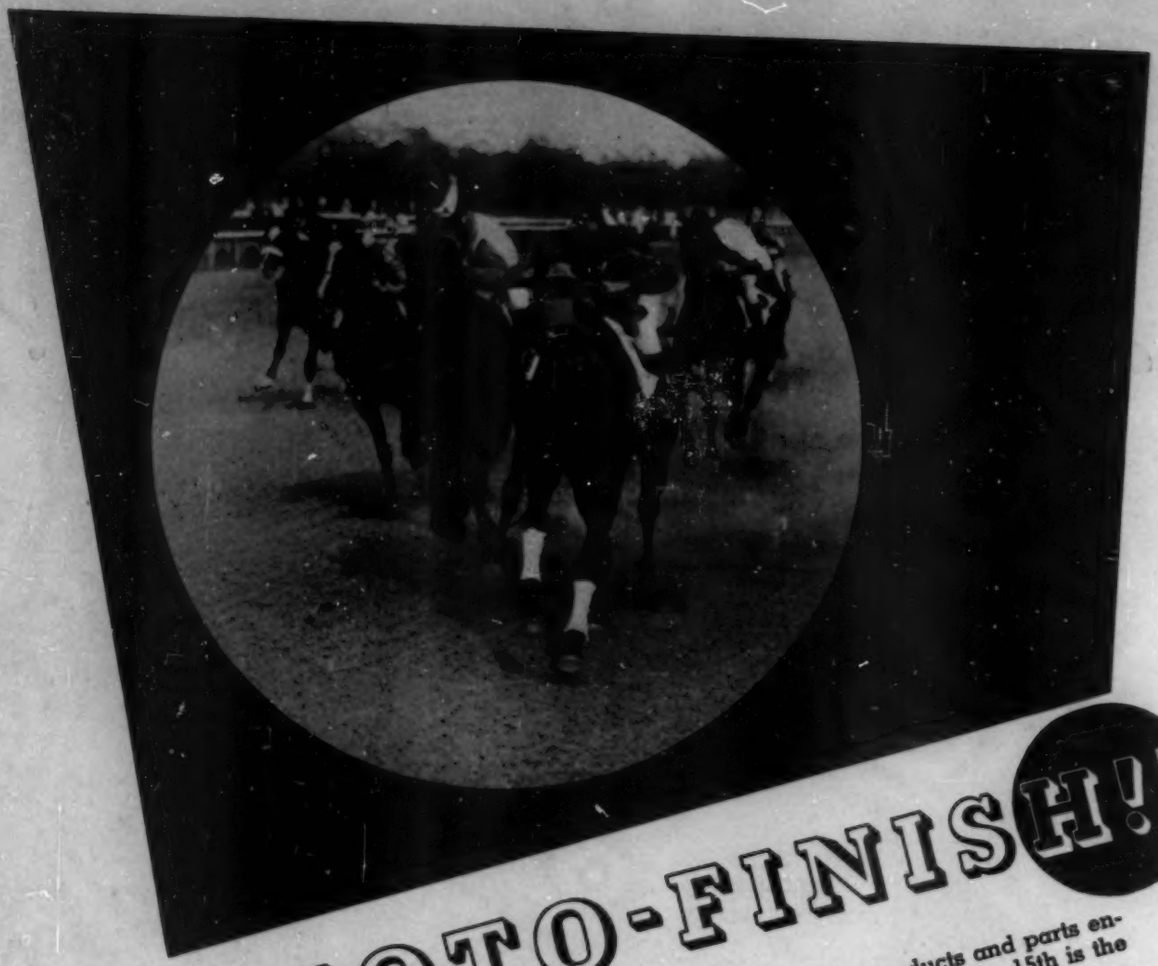


PHOTO-FINISH!!

Down the stretch thunder the thousands of splendid plastic products and parts entered in the third annual MODERN PLASTICS COMPETITION. September 15th is the closing date.

No one . . . not even the experts on our staff . . . can forecast which of these plastic applications will receive the awards.

But here is one thing you can be sure of—regardless of which products are the winners . . . to each will accrue publicity, prestige and acclaim . . . by the industry, the press and public . . . greater than winners of a MODERN PLASTICS COMPETITION ever got before.

Why?

Simply because this year's COMPETITION is the biggest ever . . . because *this* has been plastics' greatest year . . . and because after the phenomenal advances *already* made by the industry, the *public* too is interested — enthusiastically — in today's plastics.

IF YOU HAVE NOT YET MADE ENTRY IN THE MODERN PLASTICS COMPETITION, do so at once. There is still time to get under the wire before the judges begin their task of choosing 1938's outstanding applications!

Write for entry blanks. Any number of entries permitted. No fees nor obligations of any kind.

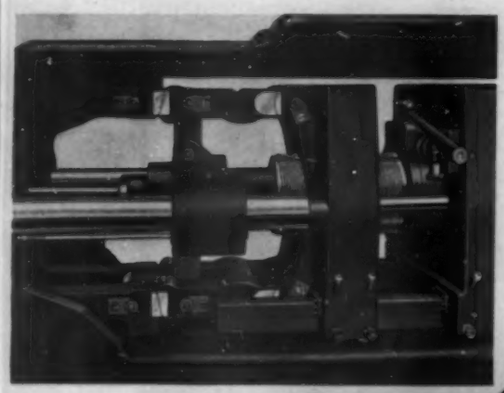
MODERN PLASTICS
425 FOURTH AVENUE
NEW YORK, N. Y.

MODERN NEEDS *Demand*

Again THERE IS A NEW *I.M.C.* LESTER DESIGNED FULLY AUTOMATIC INJECTION MOLDING MACHINE TO MEET THEM

N. Lester, President of Lester Engineering Company, now crowns his 21 years of experience in the Pressure Casting Equipment Field with the development of this new I.M.C. Fully Automatic Injection Molding Machine. The construction of this machine differs from all other Injection Molding Machines now offered. Its new features are outstanding developments—the result of careful study of modern molding requirements.

Model illustrated has 4 ounces capacity, 40 square inches injection area, and plasticizes 50 lbs. of material per hour. 6 and 8 ounce machines of same design are also standard. For even larger castings special machines can be built to order. Induction heating can be supplied if desired. Write for complete description.



BEAM CONSTRUCTION

ACCURATE AND RAPID MOLD SET-UP

LARGER SPACE FOR MOLD MOUNTING

IMPROVED HEATING CYLINDER IDEALLY SUITED FOR ALL TYPES OF MATERIAL

DUAL HEAT CONTROL FOR CYLINDER

Positive Mold Locking Mechanism through wedge action, coupled with rigid beam construction, insures against *Flash*. Tapered Toggle Link Thrust Blocks take the tremendous injection force off the link pins

Accurate and rapid mold set-up through Worm and Worm Wheel Adjustment of Mold Mounting Plate. Simple turning of the crank, shown in the insert, moves the Mounting Plate by means of large, Forged Manganese Steel Screw.

Patents granted and others pending covering the principal features of the machine.

Representative:

J. C. AUSTERBERRY'S SONS
333 Curtis Bldg., DETROIT, MICH.
1254 Builders Bldg., CHICAGO, ILL.

STANDARD TOOL CO.
LEOMINSTER, MASS.

DUGAN-CAMPBELL CO.
AKRON, OHIO

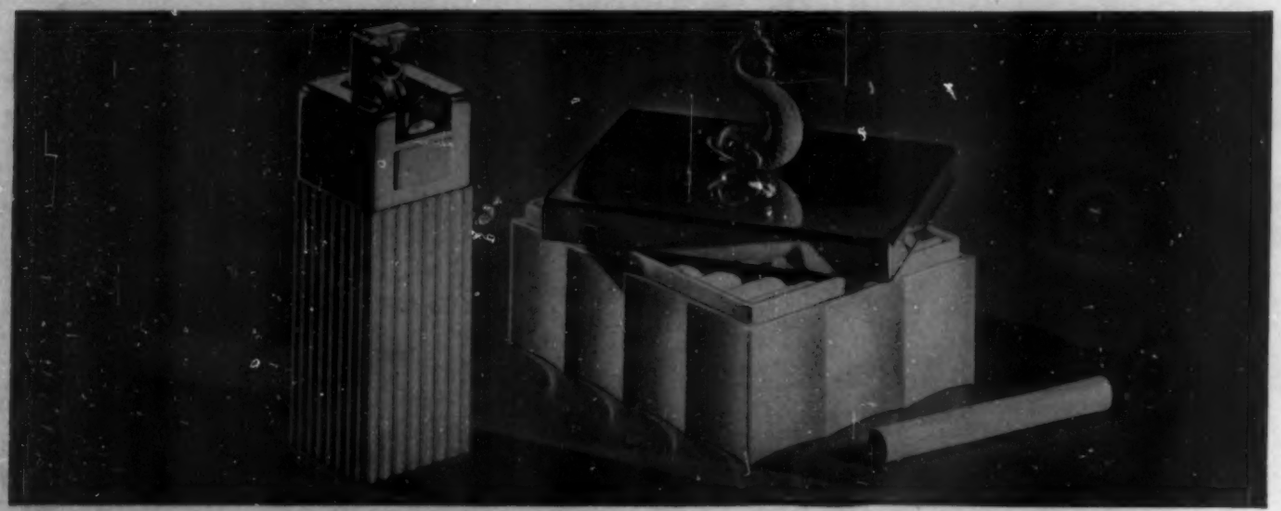
INDEX MACHINERY CORPORATION

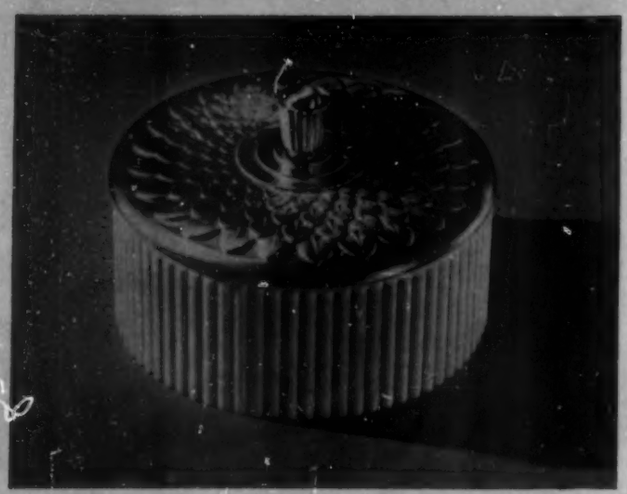
CENTRAL AVE., - CINCINNATI, OHIO

Beetle

GIVES UNUSUAL APPEAL TO ORDINARY ARTICLES

Ordinary, commonplace articles for everyday use, such as cigarette lighters and boxes, can be turned into objects of great interest and attention when molded of Beetle*. The two shown here illustrate how Beetle's lustrous color and smooth-textured surface lend charm to these items. Note, too, how well Beetle harmonizes with the metal parts of the design and enhances their attractiveness.





AND GIVES THEM POWER TO ATTRACT ATTENTION

This interesting powder box, molded of Beetle and topped with a polished metal cover, has strong attention-getting power, due to its color and the novelty of its design and decorative effects. The ribbed effect, so difficult to obtain with other materials, is a simple matter when Beetle is used — a one-step molding operation.

If you make articles for daily use, why not let Beetle's staff help you give them a new and unusual sales appeal?

BEETLE PRODUCTS DIVISION OF AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA • NEW YORK, N. Y.
Pacific Coast Representative, Electrical Specialty Co., Inc., San Francisco

*Trade-Mark of American Cyanamid Company applied to urea products manufactured by it

it's all color and in all colors

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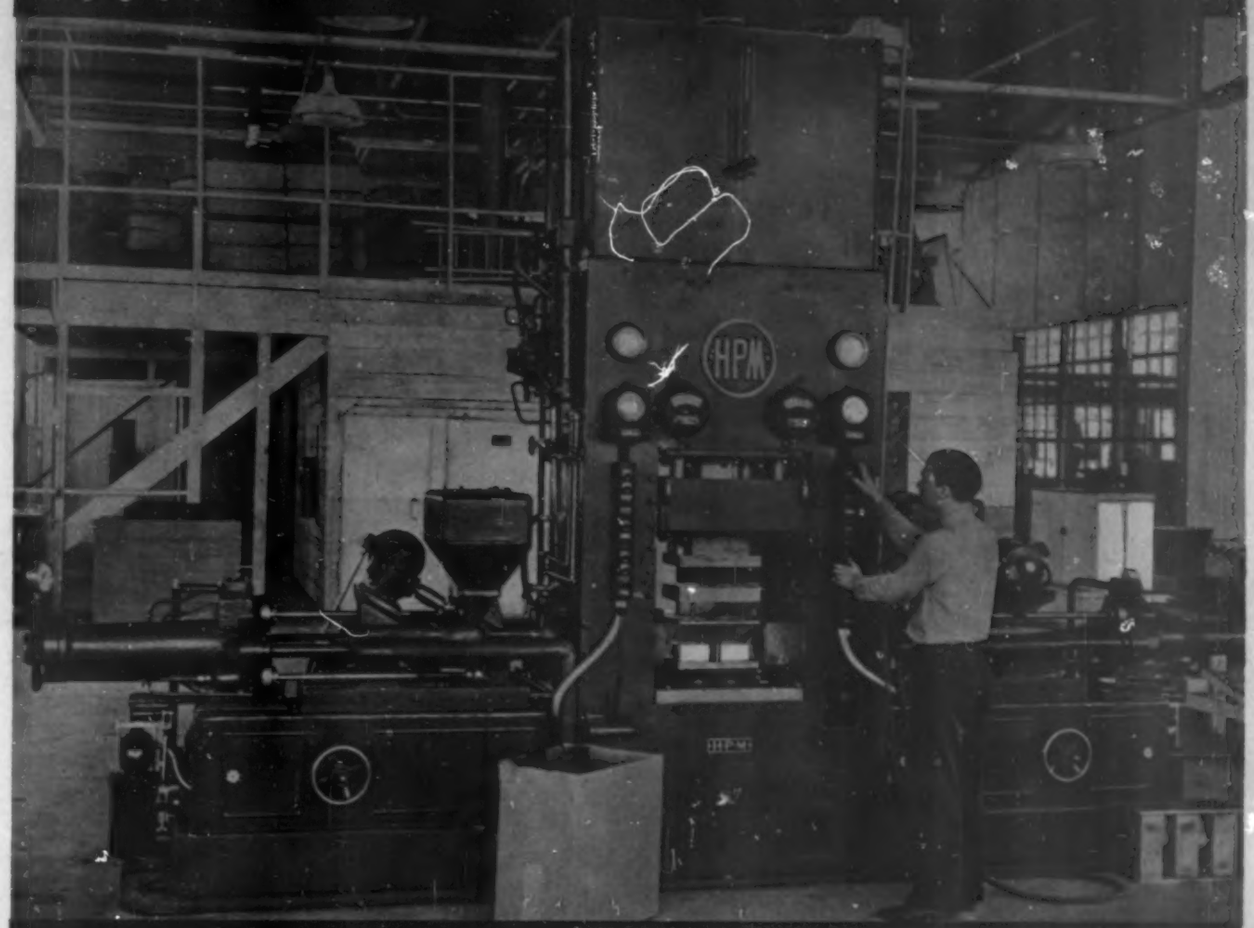


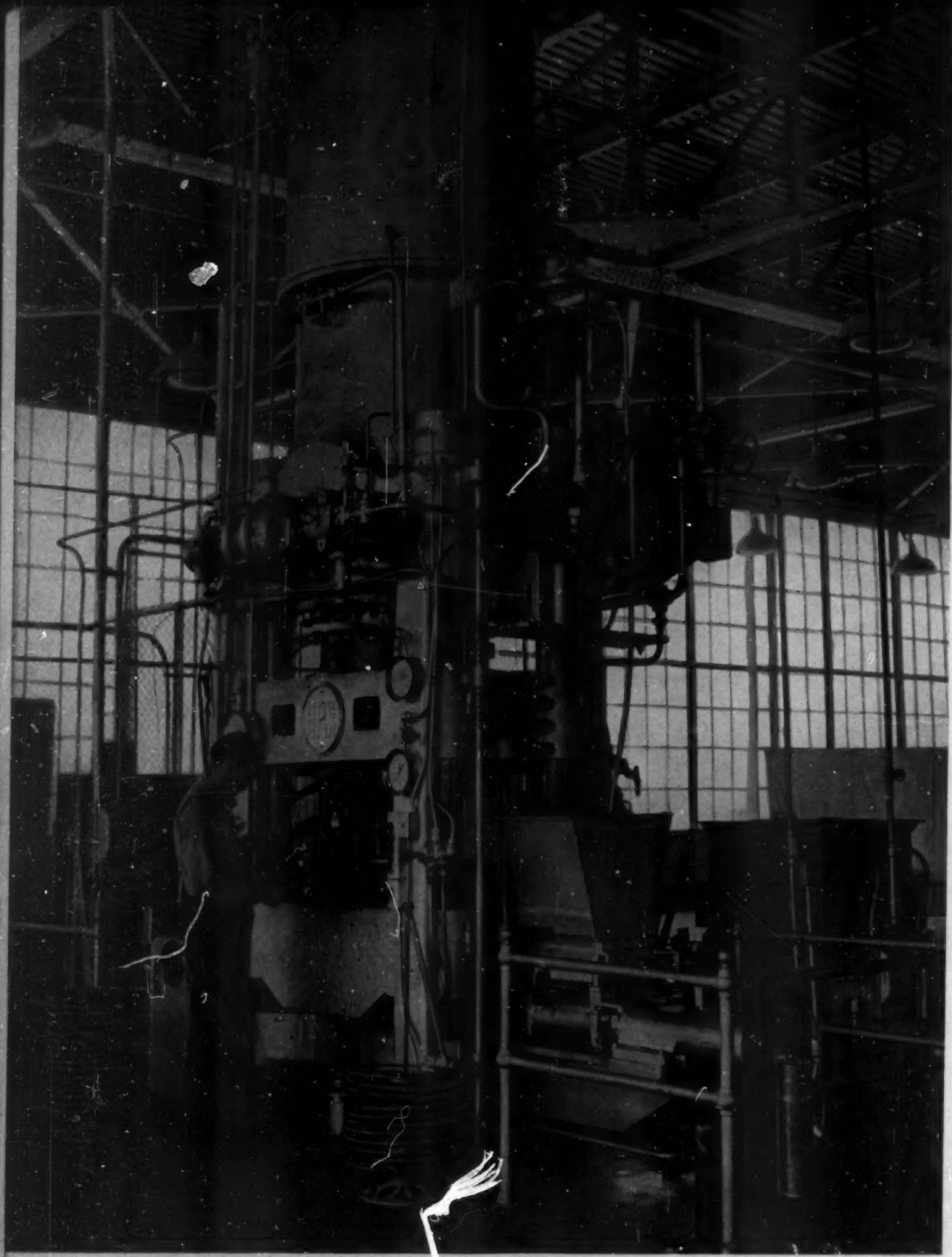
THE BEGINNING—OR THE END?

by L. T. BARNETTE*

Three years ago, an ounce and three-quarters was standard capacity for injection molding machines. Today, machines are built to handle from six to twenty-four ounces of thermoplastics per shot

THE IDEA OF MOLDING LARGE ARTICLES BY the injection principle was really conceived as far back as 1928. H. A. Husted, the inventor of the steel reinforced hard rubber Safety Steering Wheels, in his anxiety to produce his product in colors, began experimental work on different plastic materials. All thermo setting materials available in colors at that time were tried, but they failed on the freeze test. Steering wheels for this test were placed in a refrigerator at 60° below zero Fahrenheit for 72 hours. When brought out in room temperature, if there were any cracks in the covering material, they were rejected. Off-hand, this appears to be a comparatively simple and easy test to pass, but the fact that the steel rim reinforcement is mechanically attached to the hub at three or four points by the spokes seems to cause enormous and uneven strains and stresses on the rim section. This strained condition usually is

* Thermo-Plastics, Inc.



This 3-cylinder injection press is capable of plasticizing 68 lbs. of thermoplastics per hour and can inject from 6 to 18 ounces per shot at the rate of 3 to 1 shots per minute. It stands 21 feet, 7 inches in height. A similar press with 500-ton mold clamp and capacity of injecting 23 ounces per shot per minute is being built for this plant. The above press is able to turn out an automobile steering wheel every 45 seconds

more or less localized. A crack in the material on the rim will sometimes open up as much as 1/8 in. during such an experiment.

Meanwhile, the trade was clamoring for colored steering wheels and some were fabricated and sold in hard rubber materials, but due to the fact that it was impossible to control color shades accurately and the costs were prohibitive from a compound standpoint, Husted continued to search for a better material more suitable for this application. After several years of constant research, cellulose acetates were tried experimentally, and while the first materials used were unsatisfactory, the revisions in formulas and compounds soon made it apparent that they were the most ideal for steering wheel purposes. Husted then designed and fabricated a transfer type of wheel mold incorporating three plungers with material cavities in the upper half. This mold was heated until the material was sufficiently plastic and then pressure applied to the pistons so that they pushed the plastic material into the wheel cavity in the tightly clamped mold.

During these experiments, it was particularly noted that enormous pressure was necessary in order to flow and weld the material. Furthermore, many different kinds of clamps were used on the mold in order to keep it securely closed. Due to the fact that it was necessary to chill the cavity before removing the wheels, a four or five minute cycle was required. The expense of this type of mold was therefore too great for the volume of production secured; consequently, Husted started to work on a large injection type press to perform the various functions required.

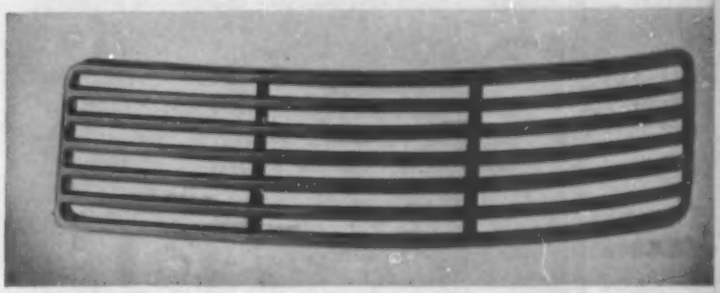
Meanwhile, to prove that the cost of cellulose acetate materials was not prohibitive for steering wheel purposes, production was started by compression molding and resultant orders indicated an exceptionally large volume market. The speed and enthusiasm with which wheels of this type have been accepted by the trade generally within the last three years bears mute testimony as to the importance of this original experimental work.

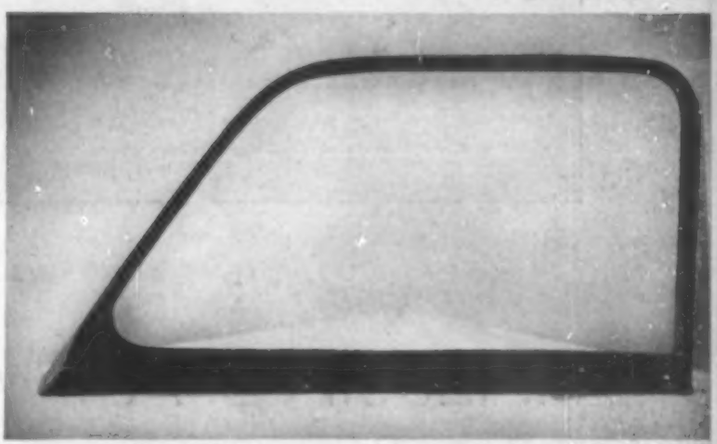
Cellulose acetate material suppliers generally were skeptical regarding the possibility of injection molding a piece as large as a steering wheel; in fact, advising "it could not be done." Nevertheless, preliminary details and specifications for a machine to be used for that purpose were formulated.

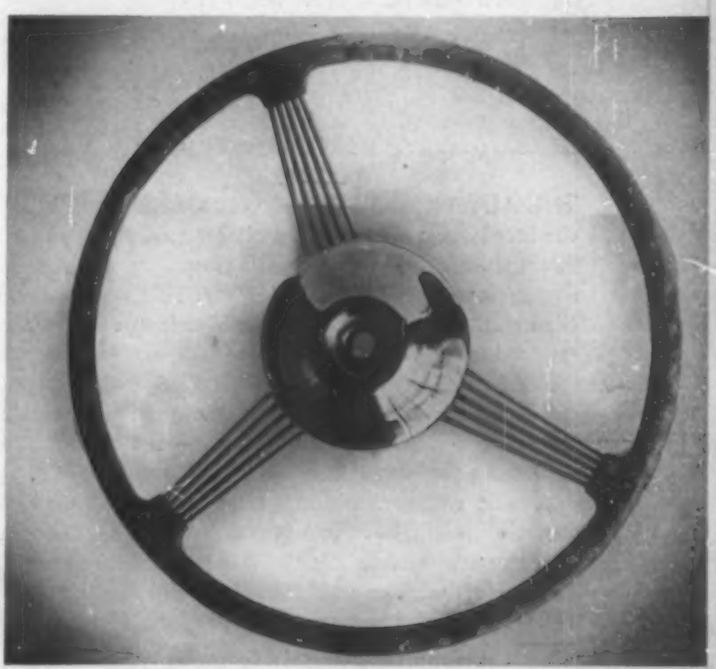
Up to this time 1 1/4 ounces of material per shot was about the maximum for commercial injection machines; consequently, it was not surprising to find that manufacturers of this type of equipment would not agree to guarantee the 16-ounce capacity considered necessary. Furthermore, the fact that cellulose acetates must cover an insert introduced molding hazards about which the equipment fabricators were fearful.

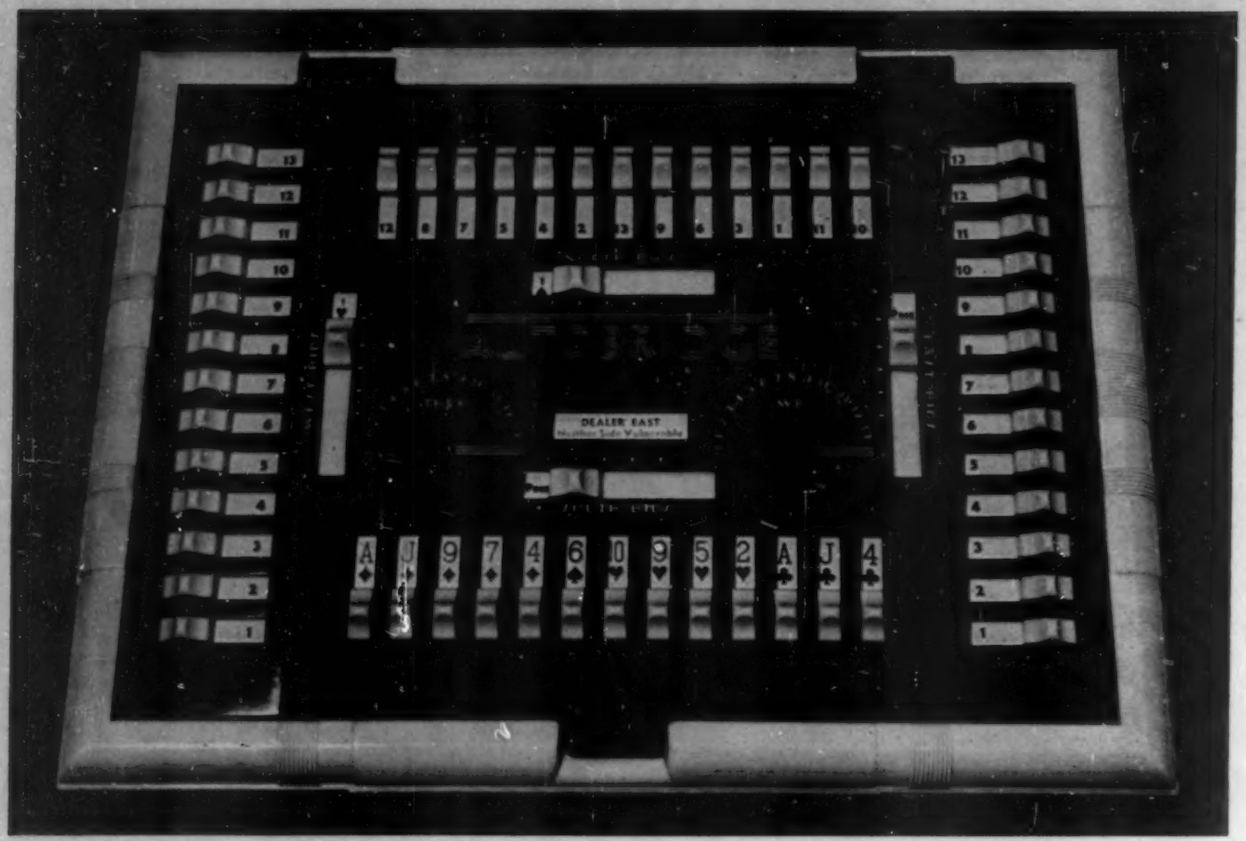
The principle of injecting from multiple extrusion chambers to a common cavity as originally conceived by Husted was entirely new and introduced anticipated difficulties in material temperature control. Also, the need for simultaneous action on the extrusion pistons as well as the maintenance (*Please turn to page 58*)

Projected area, surface cavity area (both halves) and weight of the moldings below are as follows: Radiator grille section 14.15 sq. in./ 152 sq. in./ 4 3/8 oz. Garnish molding 95.26 sq. in./ 475 sq. in./ 14 oz. Steering wheel 41 sq. in./ 134 sq. in./ 14 oz. These parts have been produced experimentally but are not yet in actual production









Engineered and molded by the Plastics Department, General Electric Co., the de luxe Autobridge has a Textolite base, Plaskon frame and Fibestos slides

FINESSING A MARKET

by FREDERICK W. JOHN*

Introducing one of the first commercial applications of molded-laminated materials

THE AUTOBRIDGE PLAYING BOARD IS PERHAPS the first large game produced almost entirely of plastics. It provides a lone player with simple or intricate bid sheets to test his skill in bidding at bridge and playing his hand. The application is unique in the fact that in its production are used phenolic, urea, acetate, phenolic molded-laminated and fabricated laminated materials. Each performing a distinct and essential function in attaining the characteristics desired by the manufacturer in the completed game.

Pressed wood, cardboard, cloth and metal were the materials utilized in the original Autobridge. Poor appearance was effected by the inherently drab assembly. Because of warpage and variable shrinkage, manipulation of the slides was extremely difficult. Punching inaccuracies, in addition to shrinkage and warpage caused the slots to improperly register with the deal sheet, inserted beneath them. The cloth hinge after repeated use, wore to an extent where it not only detracted from the appearance, but also added to the general inaccuracy of the assembly.

Autobridge, Inc., was attracted to plastics by inherent good appearance, molded color, controlled accuracy, durability and the attractive design possibilities which could be incorporated. To completely exploit the available market, it was decided to produce two models—a standard and a de luxe.

Both designs should of course, be considered in their entirety from an artistic standpoint. But, for ease of description and understanding let us briefly consider the component parts of each separately, those of

* Application engineer, Plastics Department, General Electric Company

the de luxe first and then those of the standard playing board. The wealth of color which plastics offer to the designer complicated the selection of a suitable color scheme. To present the most attractive, yet conservative and practical assembly a black top and ivory base were chosen. Black was decided upon to provide suitable contrast to the printed white deal sheet, which is placed beneath the top when the game is played. Taking cost into consideration it was logical to choose a phenolic molding compound for this component. A striking color background is effected by the ivory urea base.

Considering the limitations imposed by the requisites of the game, the base from an engineering standpoint is ideal. The stiffening effect provided by the periphery, the molded-in ribs beneath the major surface and the proper wall thicknesses all make for a strong, rigid cross section. Correct and careful molding insures accuracy and freedom from objectionable warpage.

The molded top required thin, flat cross sections, profusely slotted, to provide visibility of the deal sheet. By correct design this was made possible by the relatively thick raised center section, into which is depressed the Company monogram and other lettering. Also by the proper location of the decorative ribs in the thinner-slotted outer rim.

From experience with the original game board it was found that the metal slides proved not only unwieldy and difficult to operate, but they detracted from the appearance. It was, therefore, only natural to search for a more satisfactory material for this important part of the game. Cellulose acetate materials are known for their inherent flexibility. With this knowledge in mind, an ingenious, one piece injection molded slide was developed that operates smoothly in any position.

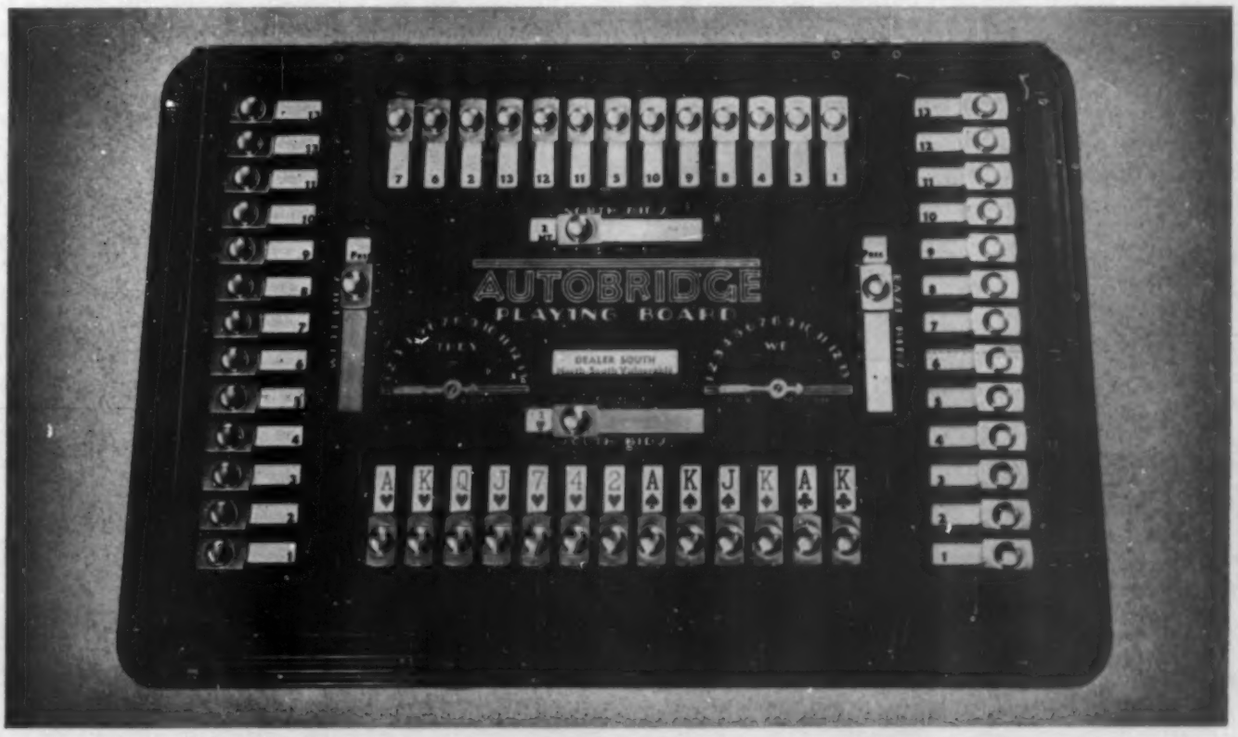
The action of the smooth molded walls of the new slides on the slot walls of the molded top exerted a pressure that provided an effortless yet completely positive performance. Two types of slides are used in the assembly—fifty-two of one type are used in the card slots and four with long molded-on tabs are used in the bid slots. Each is as easy in its action as its neighbors.

All these moldings were designed for extremely simple assembly. Let us, however, digress from this subject, for a moment. It was previously mentioned that the playing board is provided with depressed lettering and the Autobridge monogram. This lettering is, of course, not clearly legible in its "as molded" condition. Paint is wiped-in to provide the desired legibility, and to further increase the color appeal of the game.

The playing board construction is completed by attaching the molded score indicators and the numerous slides. The slides are securely held in the slots by the undercut lips and are assembled by simply pushing them into the slots from beneath.

The playing board and the base are hinged. The lugs provided on the board are drilled to align with the hinge pin slots molded into the base. Then by forcing a partially knurled pin into the drilled holes an inexpensive, substantial hinge construction is effected. With the addition of four rubber "feet" we have completed an attractive and salable product. (*Please turn to page 56*)

Metal slides operate in accurately punched slots in a laminated panel on the popularly priced Autobridge. The base is a combination of laminating and molding



WHAT GOOD IS A COMPETITION?

(EDITORIAL COMMENT)

MOST OF US NEGLECT OPPORTUNITIES NEARLY every day which we later regret when we see others enjoying the benefits of ideas that were originally our own. It is human nature to put off doing things until it is too late.

MODERN PLASTICS Third Annual Competition closes September fifteenth and if you are planning to make entries, they should be sent at once. As you have been informed, there are no entry fees and as many entries can be made as desired.

What good is a competition, anyway?

That all depends upon how you look at it. If you want to be identified with the growth of the plastics industry in any one of its various activities: If you want to align yourself and your company with the popular movement for better engineering and better design: If you want to show the product of your skill and craftsmanship to those in industry and commerce who are hungry for facts about plastic materials and new ways to use them: Then there is no better way than to make entries in the Third Annual Competition.

THE SCOPE OF THIS COMPETITION GOES FAR BEyond the readers of our publication. Winners in 1937 have been exhibited in cities and towns all over the country. Four complete exhibits are scheduled for showings through December this year.

Winners in the 1938 Competition will enjoy even greater distinction because they are to be incorporated in an Educational Industrial Film with Sound now in preparation, which will tell the complete story of plastics from a purely educational and non-advertising point of view. Prints of this film will be available to clubs, societies, associations, colleges, and other recognized organizations without cost and will be welcomed in many institutions where an advertising film would be taboo. Our original plan to exhibit the Winners at the New York World's Fair has been abandoned because the plastics industry as such is not being represented excepting, of course, those individual companies who have taken space or built buildings of their own.

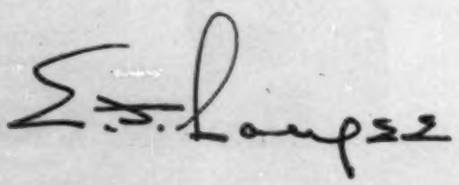
ALL ENTRIES—WINNERS OR NO—WILL BE DISplayed at our Plastics Exhibit at 425 Fourth Avenue, New York City, from October first until Christmas where they will be seen by thousands of visitors who come each year to learn what is being done with these interesting materials. To see how they can use them in their own production programs. To get ideas which are later translated into orders for designs, raw materials, molds, dies, laminated, cast and molded products which had not existed or possibly even been attempted before.

What good, then, is the Competition? Might as well ask what good is any sales or advertising effort that will bring your product directly before potential buyers. Only difference is, the Competition costs nothing but the effort. If you need more entry blanks, please let us know. We'll gladly send as many as you want.

MAY I URGE THOSE COMPANIES WHO USE PLASTics in any way in their production to make entries as their contribution to a better general understanding of these important industrial materials. Make these entries from a selfish point of view, knowing that your product will be exhibited and publicized to many potential customers with no more cost than sending the product along for the show.

ON THE OPPOSITE PAGE, WE ANNOUNCE THE judges who have accepted our invitation to attempt to choose those most practical and effective applications of plastics in each of the groups in which entries will be divided. There are five groups this year: Industrial, Scientific, Decorative, Household, and Novelties in which Style applications will be included. All groups will be judged by one jury, the members of which are too well known to our readers and too prominent in their fields to require further introduction.

THE RE-GROUPING WAS UNDERTAKEN TO broaden the scope of each classification and to permit a more accurate evaluation of the entries submitted in each. This grouping, or classification, cannot fairly be bound with hard and fast limitations because the Plastics Industry is a new industry and each year presents problems of classification created by new and unusual entries which must be considered in the grouping which comes nearest their kin. Therefore, these classifications must be kept elastic and new groups will be introduced as new entries demand. The Household Group, for example, which was set up for the first time last year permits more equitable judging of kitchen equipment, vacuum cleaners, buffet service, and such, than when they were in competition with lamps, radios, and room furnishings. Likewise, the omission this year of a separate classification for Style or Fashion merchandise, is prompted by the limited number of entries made in this grouping last year. Novelties, of which there were vastly more entries, is the title of that grouping this year but Style and Fashion applications will still be welcomed into this classification.



GRACE ALEXANDRA YOUNG

HARVEY WILEY CORBETT

ALBERT E. MARSHALL

JUDGES OF ENTRIES MODERN PLASTICS THIRD ANNUAL COMPETITION

Grace Alexandra Young
Editor, Creative Design

Harvey Wiley Corbett
Architect

Albert E. Marshall
Consulting Engineer

Morris B. Sanders
Architect—Designer

Gilbert Rohdé
Industrial Designer

ALL ENTRIES IN THE COMPETITION MUST BE POSTMARKED NOT LATER THAN SEPTEMBER FIFTEENTH, WHICH IS THE CLOSING DATE. JUDGING WILL TAKE PLACE SHORTLY THEREAFTER AND WINNERS WILL BE ANNOUNCED IN OUR NOVEMBER ISSUE.

MORRIS B. SANDERS

GILBERT ROHDÉ

1

DOONER PHOTO

2

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DAMORA PHOTOS

THE NEW BROADWAY LIMITED

represents departures from tradition which are as striking as its new features of plan and construction

THE NEW BROADWAY LIMITED OF THE PENNsylvania Railroad, now in service between New York–Philadelphia and Chicago on a sixteen-hour schedule, inaugurates a new era in luxury and comfort in high-speed, long-distance travel with an all-room train. Its accommodations consist exclusively of private rooms of newly designed types, surpassing in completeness and luxury all previous equipment and insuring the utmost in convenience and in privacy. There are no open berths.

Cars are equipped with new lock-tight couplers and rubber draft gear so that the train stops and starts smoothly as a unit, and passage between cars is accomplished without effort or annoyance. Public cars, including lounge, observation and dining sections, depart widely from tradition in plan as well as in decorative treatment, assuming the atmosphere of a club more than that of a train.

In decorative treatment, appointments and arrangement, the interiors reflect the creative styling of Raymond Loewy, industrial designer and consultant to the Pennsylvania Railroad, working in collaboration with the railroad and Pullman designing and engineering staffs.

"What we set out to do on this train," says Mr. Loewy, "was to make it as comfortable and restful as we possibly could. Passengers have to sit around for sixteen hours between New York and Chicago, so in both public and private quarters, colors were chosen that would be restful. We could have done many things which would have been more spectacular but one would probably tire of them before the trip was finished.

"Another thing that was important was the choice of materials for the ease of maintenance, yet with sufficient endurance to remain in their original condition over a long period of time despite rough handling and wear. That is why we chose plastics wherever these materials were suitable, together with metal trim of stainless steel and aluminum to provide a minimum of scratching. Dehydrated glass is used in windows so that no frost will gather and they will always be clear in winter. All windows, of course, are laminated safety glass for greater safety and protection of travelers.

"In some cases we omitted windows entirely with the result that the space looks larger than it actually is. The Bar Lounge (Figs. 2–3) for example, has large mirrors which reflect the opposite wall of the room making it appear twice its size. Informal arrangement of comfortable seats and built-in sofas suggest the atmosphere of a smart club and provide pleasant conversational corners where time passes quickly, unnoticed."

Beyond the Lounge proper, is a small but complete bar with laminated plastic top built-in the form of a quarter-circle with an interesting mirror arrangement, the reflections of which complete a full circle to the eye. Transparent plastic rods are used in the back-bar to keep glasses in place. There is also a card room completely equipped, a barber shop, shower bath, and office for the train secretary.

The Dining Cars (Fig. 1) are divided sectionally, a central lounge section having built-in sofa seats so that diners face each other across the aisle. In the remainder of the car, tables seating two or four passengers, each, are provided. An attractive cocktail bar, located in an anteroom, invites patrons upon entering and, opposite the walnut bar, tables and (*Please turn to page 56*)

DAMORA PHOTOS

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6

CUP HOLDERS IN COLOR

Color, Color everywhere. Color in the home, office, store. And nowhere can Color do a better job than at a soda-fountain, where it adds life and cheerfulness and whets the appetite.

Lily-Tulip Cup Company knows a thing or two about Color appeal, and that's why Plaskon* finds a job in fountain cup-holders. These smart holders of green and ivory Plaskon, with their contrasting chromium handles, are a far cry from the dented nickel-plated holders of yesterday.

Color, of course, is only half the story. Plaskon's toughness, lightness, its chip-proof, rust-proof lustre, and the way a damp-cloth can keep it sparkling clean, all means it's the ideal material for fountain accessories. Molded by Northern Industrial Chemical Company.

PLASKON

REEL BOX

Fishermen are funny people. They fondle their tackle and reels like dowagers fondle their jewels —and take just as good care of them. Which means if you want to please a fisherman, package your tackle in a permanent type of container.

That's what the South Bend Bait Company did with the reel set shown here—put it in a rich and solid-looking plastic box with a Plaskon cover. It keeps the reel dry and keeps out the dust, and the ivory color gives appeal to the whole package. And Plaskon cannot rust, chip, dent or stain . . . can be molded into containers of almost any shape —to fit almost any type of product. Incidentally, the idea of permanent containers also applies to scores of other products—from watches to razor blades.

Kurz-Kasch, Inc. molded this reel box for the South Bend Bait Co.

PLASKON
2121 SYLVAN AVE.
CANADIAN AGENT CANADIAN

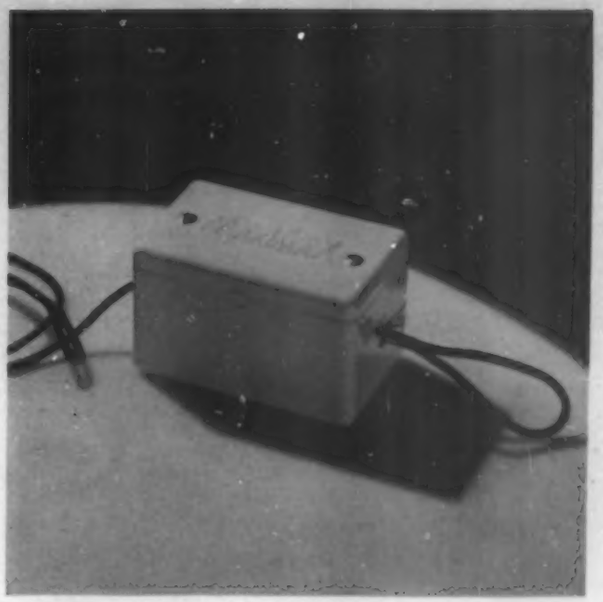
Trademark Reg. U. S. Pat. Off.

SLIDING SHARPENER

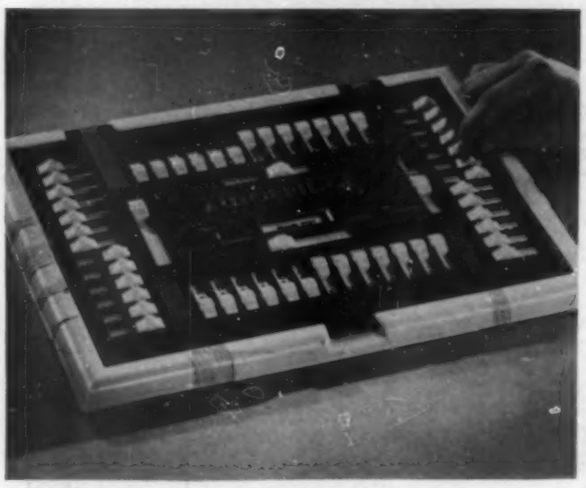
It's really very simple: slip in your dull razor blade, drop the loop over the hook on your bathroom door, stretch out the cord, and zip the Maximax back and forth a few times. Out comes your blade, honed and sharpened like new—by a stropping device actuated by the movement of the cord.

Maximax, Inc., Chicago, is the sponsor of this clever accessory, and its success is mostly due to the fact that it makes stropping blades less of a chore and more of a game—in a word, its gadget-appeal. Its lustrous, clean-looking Plaskon case, of course, increases its appeal, and is supremely practical, eliminating all danger of rusting and chipping.

Midwest Molding & Mfg. Co. are the molders.



MOLDED COLOR



COLOR BY JURY

When Ely Culbertson, moving spirit of the Autobridge Company, planned a deluxe model Autobridge, he called in a jury of leading stylists and department store buyers for advice. Out of all the color combinations offered, the jury unanimously selected Plaskon Ivory for the 20" base—which proves again the universal appeal of this soft, rich Plaskon color, and its ability to put almost any product in the deluxe class.

Autobridge playing boards, you know, improve your bridge game by automatically correcting your errors and by showing how bridge experts play a variety of hands. Sitting at the board and sliding the little knobs is just like peeking over the shoulder of three experts—all at the same time.

Phenolic molded was used for the hinged top, cellulose acetate was used for the fittings, while the big portion—the one-piece base—was molded of ivory Plaskon. General Electric's Plastic Department engineered and molded it.

COMPANY INCORPORATED
TOLEDO, OHIO
INDUSTRIES LTD., MONTREAL, P.Q.

COURTESY BAKELITE

TRANSLUCENT BLINDS AT JORDAN'S

Laminated plastic slats admit light, prevent glare, have lasting finish

JORDAN MARSH COMPANY, BOSTON, WAS among the first to display the new Rex Translucent Venetian Blinds which are made with laminated plastic slats of S-curve construction to prevent sagging and to provide compact nesting when the blind is lifted. The S-curve also gives better ventilation than flat slats when closed.

Translucency, of course, was the first consideration in choosing a plastic material for venetian blinds. Either natural or artificial light passing through gives a pleasant glow without glare. When the blinds are closed to shut out direct rays of the sun, the room is not darkened as it is when opaque slats are used. There are further considerations, however, that recommend plastics to this use. They clean easily and since their finish goes all the way through, it is permanent beyond any applied finish. They are unaffected by water, alcohol or household cleaning fluids. Being insulation in themselves, plastic blinds keep out summer heat and winter cold. Hardware is concealed by a facia valance board and the blinds are available in white, cream, amber, scarlet, dark red, dark blue, turquoise blue and green. A special light-fast phenolic laminating compound is the plastic employed. They are manufactured by the Rex Company, Inc., and merchandised through the Martin Bennett Company.

STOCK MOLDS

SHEET SIXTY-ONE

These splendid premium items of molded urea are available from stock molds in several colors. Quotations will be sent to interested executives who write on business stationery

---

663, 664, 665, 666. Nest of measuring scoops, 1/4, 1/3, 1/2 and 1 cup capacity

667. Tumbler with stenciled design. 2 1/2 in. diameter at top, 3 9/16 in. deep inside

668. Dual liquor jigger 3/4 oz. and 1 1/2 oz. capacity

669. 3 in. funnel. Spout 5/16 in. diameter

670. Biscuit cutter 2 1/4 in. diameter

671. Biscuit cutter 1 3/4 in. diameter

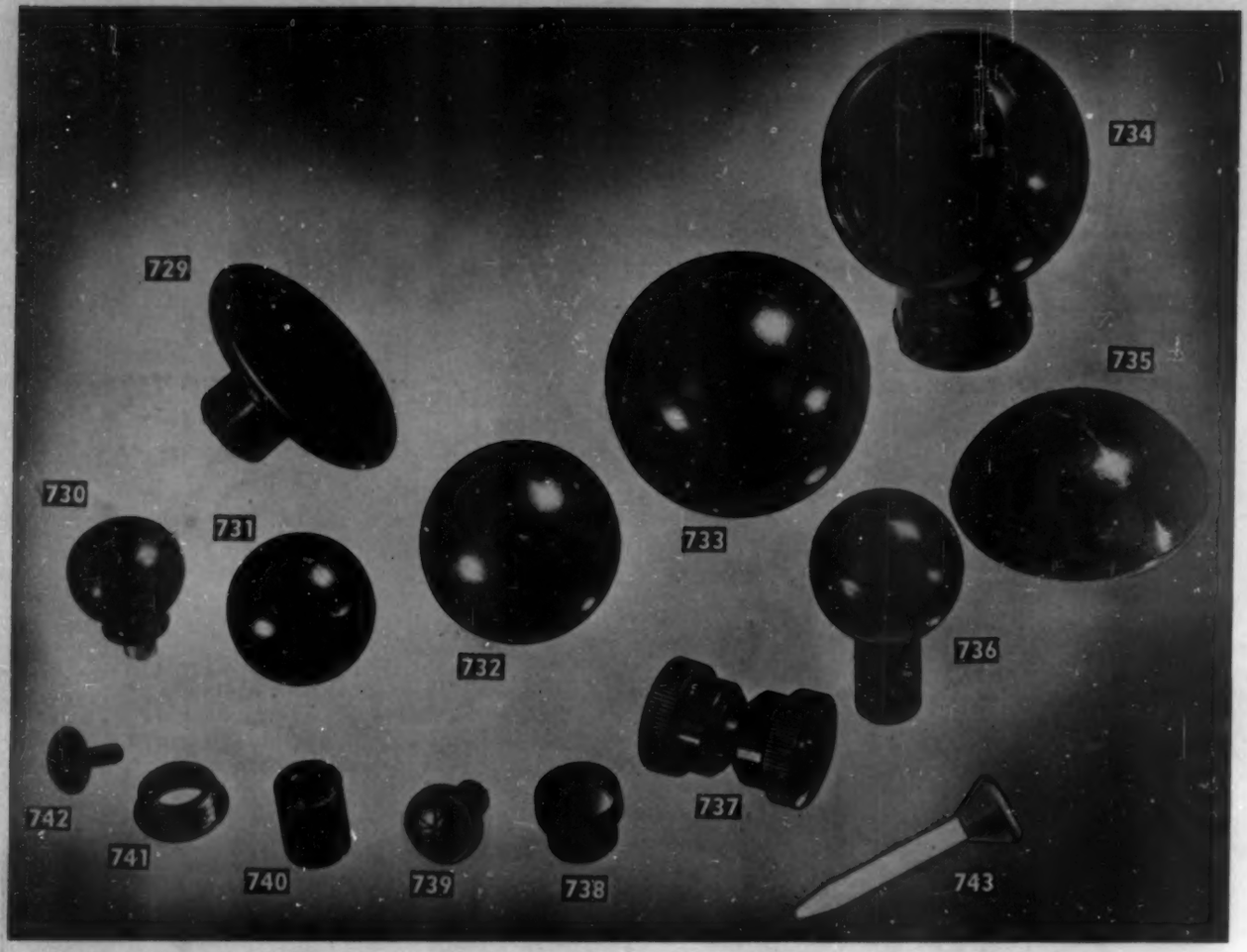
672. Beverage jigger 1 11/16 in. diameter, 2 1/4 in. high

673. Coffee measure, one tablespoon capacity

674. Cake knife, 8 1/2 in. long

675. Sugar scoop about 5 1/2 in. long

Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits



STOCK MOLDS

SHEET SIXTY-TWO

Control knobs, handles and bushings for a variety of uses are obtainable from stock molds. Inquirers should write on company letterhead and specify item number as well as sheet number when writing for samples

---

729. Lid knob 7/8 in. high and 1 3/4 in. diameter. Brass insert 1/4 in. diameter

730. 5/8 in. knob with aluminum stud

731. Gear shift ball handle 1 in. diameter with 5/16 in. brass insert

732. 1 3/8 in. ball handle. Opening 3/8 in. diameter

733. 1 7/8 in. gear lever or beer faucet handle. 3/8 in. opening at base

734. Beer tap knob with 1 1/2 in. diameter opening for metal nameplate. Threaded opening at base 5/16 in. diameter. Approximately 2 1/4 in. high overall

735. 1 3/4 in. mushroom type handle for washing machines, ironers, etc. Brass insert 3/8 in. diameter

736. 1 in. ball handle with 7/16 in. shank. No opening at base

737. 3/4 in. standard terminal knob with knurled sides

738. Twist knob with knurled edge and brass insert. 1/8 in. diameter, 7/16 in. high

739. 1/2 in. knob with aluminum stud insert for riveting. Knurled sides and decorated top

740. Injection molded push button knob, 1/2 in. high and 3/8 in. diameter. Will fit any standard push button tuning device

741. 3/8 in. bushing

742. 1/8 in. metal screw 13/16 in. long with 7/16 in. decorative molded plastic head

743. Golf tee with white shank and red head, 1 1/2 in. long

Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits

PLASTICS AS STRUCTURAL MATERIALS FOR AIRCRAFT[1]

by GORDON M. KLINE
National Bureau of Standards

INTRODUCTION: A NEW DEVELOPMENT IN aircraft construction which may make possible the quick production of thousands of airplanes in the event of a national emergency, has received considerable attention recently in the newspapers. A plane built by the Clark Aircraft Corporation has a fuselage molded in two parts of thin veneers of wood impregnated with phenolic resin and cemented together with more of the same resin. Other airplane manufacturers in this country and abroad are known to be experimenting with a similar goal in mind, namely, the molding of large members of aircraft in one piece. This subject was reviewed by G. M. Kline in Technical Note No. 628 of the National Advisory Committee of Aeronautics and in a paper presented at the 1938 Annual Meeting of the Institute of the Aeronautical Sciences and subsequently published in the Journal of that Institute. The material published herewith has been taken in large part from those two sources. It is of interest to note that the National Bureau of Standards at the request of and with the financial assistance of the National Advisory Committee for Aeronautics, is initiating an experimental investigation of the materials and processes involved in molding airplane structures.

PLASTICS AND AIRCRAFT HAVE UNDERGONE their major development during the past twenty years. Both are industries in which many optimistic predictions for a generation of progress have become realities within two to five years. Currently, efforts are under way in England and Germany to link more closely these two relatively new and expanding industries by utilizing plastic materials for the construction of aircraft. Admittedly this is a development the realization of which would appear to require many years of experimental research on materials and fabrication problems. However, noteworthy progress has already been accomplished by Kraemer[2] in the German Aeronautical Institute, by de Bruyne[3] and his associates in the laboratory of Aero Research, Limited, and by de Havilland,[4] King, and Walker of the de Havilland Aircraft Company, Limited. The work of these and other investigators[5] is summarized in this paper.

Most of the experimental work on the use of plastics in aircraft construction has been with the phenol-formaldehyde resin type, known in this country by such trade names as "Bakelite" and "Durez." This material is the least expensive of the synthetic resins and is thermosetting, i.e., it cures during the molding process to an infusible, insoluble mass. The thermoplastic materials, such as the cellulose derivatives, and vinyl and acrylic resins, which can be alternately fused and hardened by raising and lowering the temperature, are probably too liable to cold flow to be useful as structural materials.

Phenolic plastics are usually made up of two distinct ingredients, the resinous binder and a reinforcing agent. The raw materials for the resin are generally formaldehyde and phenol (also known as carbolic acid) or technical cresol. Phenol, like cresol, is obtained as a by-product of the coal distillation industry, or it is prepared synthetically by processes such as the alkaline hydrolysis of chlorobenzene. Formaldehyde, which is normally a gas, is made by the catalytic oxidation of methyl alcohol. Furfural, an aldehyde which can be obtained from various natural sources, for example, oat hulls, cornstalks, and the like by distillation with acid, is sometimes substituted for the formaldehyde. The selection of a reinforcing material and its incorporation into the composition in such a manner as to utilize to a maximum its capabilities, has been the subject of considerable investigation already and will continue to claim the attention of workers in this field. In the usual molding composition the resins are mixed with ground or shredded fibrous fillers, such as woodflour, cotton flock, or comminuted canvas. These fibrous materials not only reduce the cost of the plastic, but also improve its mechanical properties, particularly with regard to tensile and impact strength. Plastics of greater mechanical strength are

1. Paper presented at the Annual Meeting of the Institute of the Aeronautical Sciences, January 24, 1938. Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.
2. O. Kraemer, Synthetic Resins and Their Development for Airplane Structural Materials, Jahrbuch 1933 der Deutschen Versuchsanstalt fur Luftfahrt, Part VI, pp. 69–81.
3. N. A. de Bruyne, Plastic Materials for Aircraft Construction, Journal of the Royal Aeronautical Society, Vol. 41, pp. 523–590, July 1937.
4. G. de Havilland, Filled Resins and Aircraft Construction, Journal of the Aeronautical Sciences, Vol. 3, pp. 356–357, August 1936.
5. For a complete bibliography see G. M. Kline, Plastics as Structural Materials for Aircraft, N.A.C.A. Technical Note No. 628, December 1937.

Table 1. Tensile Strengths of Various Fibers

Material	Tensile strength lb./sq. in.	Specific gravity	Maximum ratio of tensile strength to specific gravity lb./sq. in.
Cotton	40,000– 62,000	1.55	40,000
Hemp	114,000–131,000	1.48	89,000
Ramie	99,000–114,000	1.52	75,000
Flax	85,000–156,000	1.46	107,000
Silk	50,000– 63,000	1.36	46,000

produced by employing paper or cloth as the reinforcing medium. These laminated materials are prepared by impregnating the sheets with a solution of the resin while it is still in a soluble state, drying, and then bonding many layers together by the application of heat and pressure. This treatment converts the resin to the infusible, insoluble state and yields a hard, dense product which will not delaminate and possesses excellent mechanical strength and weathering resistance. Phenolic laminated materials of this type have already found many applications in the aircraft, automotive, railroad, telephone, power, and building industries.

Recently two other types of reinforcing materials have been investigated with particular reference to their employment in plastics for aircraft construction. Kraemer[2] observed that products superior to the paper- or cloth-laminated type in certain physical properties, especially modulus of elasticity in both tension and compression, could be prepared by impregnating extremely thin wood veneers of 0.1 to 0.3 mm. (0.004 to 0.012 in.) thickness with resin and forming them into a multi-layered cured sheet in the usual manner. Better strength properties were obtained by laying every tenth veneer with the grain of the wood at right angles to the principal grain direction than by pressing the veneers together with all grain directions parallel. De Bruyne[3] has worked primarily with cord or long fiber reinforcing agents in order to obtain maximum tensile strength, incorporating only the minimum amount of resin required to bind these fibers together. The tensile strength of various fibers which could be used for this purpose are shown in Table 1. By subjecting the fibers to an initial stress during the process of molding, a considerable increase in the modulus of elasticity in tension is obtained. However, this kind of reinforcement has very little effect on the ultimate compressive strength which remains about the same as for the pure resin. Similar results with fibers of agave, sisal, and aloe have been reported by Riechers.[6]

Some of the physical properties of these various types of plastics which are pertinent to their use as structural materials for aircraft are summarized in Table 2 from various publications. Similar data reported in the literature for the materials which have been employed for fabricating aircraft, namely, high tensile steels, aluminum and magnesium alloys, aircraft spruce, and birch plywood, are quoted for purposes of comparison.[7]

Density

It will be noted in Table 2 that the specific gravities of the reinforced plastics are greater than those of spruce and plywood but are considerably less than for the metals. The advantage of low-density materials in permitting thicker wall structures is considered in detail by Shanley[8] and by de Bruyne.[3] Tuckerman[9] states that for a given modulus-density ratio "the wall with the greater thickness will have somewhat greater stability. Where the use of the heavier material would require extremely thin walls, there is a very certain advantage, but of uncertain and variable magnitude, (*Please turn to page 62*)

6. K. Riechers, Plastics in Aircraft Construction, Luftwissen, Vol. 4, pp. 235–242, August, 1937. Cf. N. A. C. A. Technical Memorandum No. 841, November, 1937.

7. The values listed in Table 2 have been compiled from the following sources: for stainless steel, chrome-molybdenum steel, aluminum alloy and aircraft spruce, from A. Klemin, Metal Airplane Construction, Aero Digest, Vol. 27, pp. 43–45 and 112–113, July, 1935; for magnesium alloy, from Z. Jeffries, Light-Weight Metals in the Transportation Industry, Metals Technology, Vol. 3, Symposium on Role of Metals in New Transportation, pp. 21–39, October, 1936, and a bulletin on "Dowmetal" published by the Dow Chemical Company; for birch plywood and birch-reinforced resin, from Kraemer (see footnote 2); and for resins reinforced with paper, fabric, and cord from de Bruyne (see footnote 3), M. Langley, Plastics in Aircraft Construction, British Plastics, Vol. 9, pp. 5–8, June; pp. 55–58, July; and pp. 185–190, September, 1937, and R. Hamard, Synthetic Resins in Aircraft Construction, L'Aéronautique, Vol. 19, pp. 231–235, October, 1937.

8. F. R. Shanley, Pounds or Pounds per Square Inch, Aviation, Vol. 35, pp. 27–29, November, 1936.

9. L. B. Tuckerman, Aircraft Materials and Testing Proceedings of the American Society for Testing Materials, Vol. 35, Part II, pp. 3–46, 1935.

Table 2. Physical Properties of Reinforced Plastics, Wood and Metals
(Sources of the data are given in footnote 7)

Material	Specific gravity	Tensile strength lb./sq. in.	Ratio of tensile strength to specific gravity lb./sq. in.	Compressive strength lb./sq. in.	Ratio of compressive strength to specific gravity lb./sq. in.	Modulus of elasticity in tension (E_t) lb./sq. in.	Ratio of E_t to specific gravity lb./sq. in.	Modulus of elasticity in compression (E_c) lb./sq. in.	Ratio of E_c to specific gravity lb./sq. in.
Stainless steel (18-8)	7.85	185,000	23,600	150,000[a]	19,100	30,000,000	3,800,000	30,000,000	3,800,000
Chrome molybdenum steel (heat-treated)	7.85	180,000	22,900	150,000[a]	19,100	29,000,000	3,700,000	29,000,000	3,700,000
Aluminum alloy (24-ST)	2.80	62,000	22,100	40,000[a]	14,300	10,400,000	3,700,000	10,400,000	3,700,000
Magnesium alloy (AM58S)	1.81	46,000	25,400	35,000[b]	19,300	6,500,000	3,600,000	6,500,000	3,600,000
Aircraft spruce (Douglas fir)	0.43	10,000	23,300	5,000	11,600	1,300,000	3,000,000	1,300,000	3,000,000
Birch plywood	0.80	13,100	16,400	5,700	7,100	1,400,000	1,800,000		
Birch-reinforced resin	1.27	27,700	21,800	22,800	18,000	3,400,000	2,700,000	2, 300,000	1,800,000
Paper-reinforced resin	1.37	19,000	14,000	30,000	22,000	1,200,000	900,000	600,000	400,000
Fabric-reinforced resin	1.37	10,000	7,200	40,000	29,000	1,000,000	700,000	600,000	400,000
Cord-reinforced resin	1.37	25,000	18,700	27,000	20,100	5,900,000	4,300,000	600,000	400,000

[a] Yield point in compression.
[b] Yield point in tension. Yield point in compression is substantially equal to yield point in tension for wrought alloys.

THE IMPACT TESTING OF PLASTICS[1]

by ROBERT BURNS[2] and WALTER W. WERRING[3]

Synopsis

There are approximately 8,000,000 molded phenol plastic telephones in use throughout the Bell System. In the very nature of things many of these instruments, during their service life, will be subjected to impact forces resulting from accidental dropping. The extent to which actual breakage occurs, and consequent loss of service to the subscriber and expense involved in making the necessary replacements, is determined largely by the impact strength of the molding material. This large interest in the impact strength of plastic materials led to the development by the Bell Telephone Laboratories of pendulum type impact machines of suitably low capacity for tests of molded specimens of plastic materials, and of other equipment for laboratory impact tests of assembled apparatus. Studies and control of the impact properties of these materials have been carried on for a number of years and improvements indicated by laboratory tests have been substantiated by accurately kept field experience records.

This paper presents the results of this experience. It also reviews in part the work of the Society's Committee D-9 and attempts to point the way toward further progress in the art of impact testing of plastics. The important effect of moisture on the impact strength of molded telephone apparatus is shown, and it is demonstrated that reproducible results on test bars of phenol plastic can be obtained only when this feature is carefully controlled. For some of the thermoplastics, control of temperature as well as moisture is necessary in precision testing.

The excellence of the Izod or Charpy test using notched bars is reaffirmed but it is also shown that no single method can be expected to suffice for all the plastics. A group of three tests is suggested, and evidence is presented to show that a material proven to be strong by these tests, when properly molded, will invariably produce a strong product. These data also make manifest that a properly molded product, that is, one that truly develops the strength properties of the raw material, is the *sine qua non* of plastics testing.

TESTS TO DETERMINE THE RESISTANCE OF organic plastics to impact have been largely a development of the last 15 years. During this time the Society's Committee D-9 on Electrical Insulating Materials has actively promoted the investigation of impact testing of all types of plastic materials. The earliest work was done with increment drop tests because sufficiently sensitive pendulum machines were not available. However, the desire to determine the actual energy absorbed in breaking the specimen led to the development of pendulum type machines of suitably low capacity.[3] The need for special machines for plastics arises from the fact that the most commonly used materials have impact values between 0.10 and 1.00 ft-lb. for a specimen $^1/_2$ in. square in cross section notched to a depth of 0.100 in. A number of other investigators built machines patterned after these early ones and the development of methods of test to insure reliable and reproducible results was begun. The standard methods are now embodied in A.S.T.M. Tentative Methods D 256–34 T.[4]

Test machine

The earliest results indicated the existence of a velocity effect and it was necessary to establish a standard velocity of impact. The possible height of fall in machines of the small capacity required is limited by mechanical difficulties of design. Opposed to this it was generally considered desirable to use a high velocity of blow to reveal fully the brittleness of the material. As the height of fall of the pendulum in the usual Izod test is 2 ft., this was adopted as a practical compromise for tests of both Izod and Charpy types.

Changes in the capacity of the machines between 2 and 5 ft-lb. were not found to affect the results appreciably, but a machine of only $^1/_2$ ft-lb. capacity indicated absorbed energy values as much as 25 percent higher than those of the 2 ft-lb. machine. This was apparently a further manifestation of the velocity effect resulting from the deceleration of the light-weight hammer during fracture. Increasing the weight of the hammer of the smaller machine without other changes in design eliminated this difference.

As a result of these experiments, the design of the usual machine became fixed at 2 ft-lb. capacity at a height of fall of 2 ft. although increases to 4 or 5 ft-lb. may be made by adding supplemental weights to the sides of the hammer. An improved design, embodying the experience of a number of years with the old type was developed[5] and is now in use at several laboratories.

Test specimens

Molded plastics present a difficult problem in the production of truly representative test specimens. Differences in the method of molding the specimens may produce variations in properties which will not be representative of a properly molded useful product and conversely variations in the regular manufacturing process may result in product differences not inherent in the material. It is therefore, our practice to specify in detail the mold and molding process to be used for the production of specimens for impact tests. By these means reproducible test results can be obtained consistently and it is only by such control that the test results will be indicative of the useful properties of the material. The problem of insuring a uniformly good product from uni-

[1] Paper presented as part of a symposium on impact testing at the Atlantic City meeting of the American Society for Testing Materials on June 28, 1938 and published with the permission of the Society.

[2] Members of the Technical Staff, Bell Telephone Laboratories Inc., New York City.

[3] W. W. Werring, "Impact Testing of Insulating Materials," Proceedings, Am. Soc. Testing Mats., Vol. 26, Part II, p. 634 (1926).

[4] Tentative Methods of Testing Electrical Insulating Materials for Resistance to Impact (D 256 – 34 T), Proceedings, Am. Soc. Testing Mats., Vol. 34, Part I, p. 995 (1934); also 1937 Book of A.S.T.M. Tentative Standards, p. 1023.

[5] I. L. Hopkins, "Impact Tester for Molded Insulating Materials," Modern Plastics 13, 17, 47–48 (Oct. 1935).

formly good raw material would require the same precision of control of manufacture as that used in producing the test specimen and it is manifestly a more exacting job. This difference between specimen and product makes it necessary in the case of important molded apparatus to supplement raw material tests with impact tests of the finished product.

The choice of specimen dimensions involves the characteristics of the materials in a way not usual in metals. In many plastic materials, the maximum thickness that can be properly molded is definitely limited and such materials are used within this limitation. Molded test specimens should therefore be of similar thickness to be representative of the material. However, in testing materials for use in a particular piece of apparatus in which the thickness of section is fixed by the design, the specimen used must then conform to the thickness actually used even though this may be a size which will not develop the optimum impact properties of the material. This latter is the case for much important telephone apparatus so the specimen used in our tests is in practically all cases $^1/_2$ by $^1/_2$ in. in cross section. This is the specimen originally standardized but present A.S.T.M. practice[4] also permits use of specimens $^1/_2$ in. by any desired smaller dimension. The thin specimens are struck on the narrow side.

Efforts to relate the cross sectional dimensions of specimens, either notched or unnotched, to the energy expended in breaking them have been generally unsuccessful. For some materials the energy required to break notched specimens varies roughly in proportion to the breadth of the specimen multiplied by the square of the depth back of the notch, but this relation does not hold closely enough to permit accurate correction of even small differences in specimen size. It is therefore permissible only to state absorbed energy in terms of a standard specimen and it is necessary to hold the specimen size to fairly close limits. For the notched test the overall dimensions of the specimen may vary considerably, but the thickness back of the notch should be controlled to within ±0.002 in. However to avoid variations in clamping in the Izod test, individual bars should not vary in thickness from end to end more than 0.002 in. For unnotched tests the overall thickness becomes of greater importance and must be held to a definite maximum for specification purposes.

Type of notch

When the velocity of impact is high, the particular type of notch used is not important so long as it is sufficiently deep and sharp. In early tests various notches were tried, but the notch now used for both Izod and Charpy tests is the 45-deg. V notch with 0.010-in. radius at the bottom. This is the same shape as the standard Izod notch for metals, but a depth of 0.100 in. is used instead of 0.079 in. because of the larger cross section of the plastic specimen.

The effect of the sharpness of the bottom of a 0.100-in. deep notch on the absorbed energy value of a phenol plastic is shown in the following table:

Radius at Bottom of 45-Deg., 0.100-In. Deep, V Notch, In.	Izod Test Absorbed Energy, Ft-Lb.
0.010	0.135
0.020	0.133
0.030	0.134
0.040	0.141
0.050	0.165

Notch effects

Both notched and unnotched specimens are used in impact tests of plastics. Both indicate differences in materials which are not apparent from the usual static tests but which become obvious in the service behavior of the material. In addition the notched-bar test indicates some established differences not always shown by the unnotched test. In the case of molded telephone apparatus, impact forces during service life are usually those resulting from accidental dropping. The exact circumstances are therefore variable and uncertain. Likewise the initial stress condition in the assembled product may vary widely and is practically unpredictable. Consequently it is difficult to establish the relative significance of individual properties for a particular use. Of course, the material that excels in all properties will be the most desirable. While obviously not the exclusively significant test, the notched test is probably the most significant single test of the impact resistance of molded plastic materials.

A range of different types of phenol plastics varying from the ordinary grade of material to the least brittle material of the type is represented by the following data. In these materials the flexure strength gives no indication of impact resistance as measured on test bars.

Material	Notched Izod Energy, Ft-Lb.	Flexure Test, Modulus of Rupture, Lb. per Sq. In.
A	0.136	9600
B	0.172	8780
C	0.248	5180
D	0.686	8150
E	1.65	9930

There is unfortunately no theoretical method of calculating the effect on the strength of a part of these differences in the energy absorbed in breaking specimens. However, some idea of the magnitude of the difference which may be significant in plastic materials is indicated by the results of tests of a molded housing. It contained apparatus bringing the total weight to about 7 lb. Made of material with a notched Izod strength of 0.2 ft-lb. it would occasionally crack when repeatedly dropped from a height of 3 ft. to a soft wood floor. When made of material of 0.4 ft-lb. strength it could be dropped practically indefinitely from the same height on a concrete floor.

One comparison of the results by notched and unnotched bar tests is shown in Table I. These data are from tests of a variety of hard rubber compounds which were rated for resistance to impact breakage and the general quality of their mechanical properties by engineers responsible over a period of years for their compounding. It will be seen that the notched-bar Charpy results in every case agree with the previous experience

TABLE 1. STRENGTH RATINGS OF HARD RUBBER AS INDICATED BY IMPACT TESTS AND EXPERIENCE

Rating	Charpy Plain			Charpy Notched			Izod Notched		
	Material	Impact, ft-lb.	Experience rating	Material	Impact, ft-lb.	Experience rating	Material	Impact, ft-lb.	Experience rating
1	A	>3.0	High	A	0.372	High	A	0.295	High
2	C	2.64	High	B	0.270	High	B	0.287	High
3	D	2.17	High	C	0.252	High	C	0.272	High
4	E	1.86	Medium	D	0.235	High	D	0.234	High
5	F	1.37	Medium	E	0.229	Medium	E	0.230	Medium
6	B	1.35	High	F	0.220	Medium	F	0.217	Medium
7	H	1.32	Fair	G	0.213	Medium	H	0.182	Fair
8	I	1.28	Fair	H	0.195	Fair	G	0.158	Medium
9	G	1.10	Medium	I	0.180	Fair	I	0.135	Fair
10	J	0.70	Low	J	0.154	Low	J	0.109	Low

judgment on the material whereas the results on the unnotched Charpy do not. The notched Izod agrees with the notched Charpy except for the minor interchange of ratings 7 and 8.

Types of tests

Both Charpy and Izod tests are used and though the actual values of absorbed energy obtained are slightly higher in the case of the Charpy the relative indications are generally similar. On account of the large sample there is some tendency for the broken halves to interfere with the Charpy hammer. The Izod test has the further advantage that it permits two tests per molded bar instead of one and in fact permits test of the broken halves of bars previously tested for flexural strength, which does not affect the impact values and is a considerable economy. It is for these reasons that we use the Izod more generally than the Charpy type machine.

Effect of moisture

Studies made some years ago of the factors likely to cause variability in impact test results revealed that the moisture content of the specimen at the time of test greatly affected the results. Differences in moisture content of a few tenths of a percent which will result from only a few days of high humidity caused differences of as much as 25 to 50 percent in notched-bar strength. Obviously some "conditioning" before test would be necessary to eliminate the effects of the variable history of the specimens if the data were to be truly representative.

This effect of moisture, first observed in test specimens, has since been correlated with actual breakage of molded parts in service. It has been established as the cause of

TABLE 2. RELATION BETWEEN NOTCHED-BAR IZOD, APPARATUS STRENGTH TESTS, AND FIELD EXPERIENCE

	Notched-Bar Izod Impact Strength on Standard A. S. T. M. Test Bars, ft-lb.	Strength of Telephone Apparatus as Determined by Height of Fall Necessary to Break, in.	Relative Breakage in Field
For Dissimilar Phenolics			
Standard woodflour filled material	0.140	30	1.00
High flock filled material	0.240	60	0.40
For a Single Phenolic of Approximately 15 Percent Flock			
Batch 1	0.150	42.0	
Batch 2	0.153	43.0	
Batch 3	0.157	44.0	
Batch 4	0.159	44.5	
Batch 5	0.164	45.5	

the seasonal variations in breakage rates observed where molded apparatus is subjected to artificial heating in winter as in New York City and lacking in climates where heating of buildings is not necessary. The relation between breakage rates experienced and the relative humidity of the ambient atmosphere over a period of years is shown in Fig. 1. The effect of moisture upon the properties of the material used in the apparatus covered by Fig. 1 is shown by Fig. 2 and it will be noted that the continuous increase in notched-bar strength is most striking. The adoption of materials indicated to be

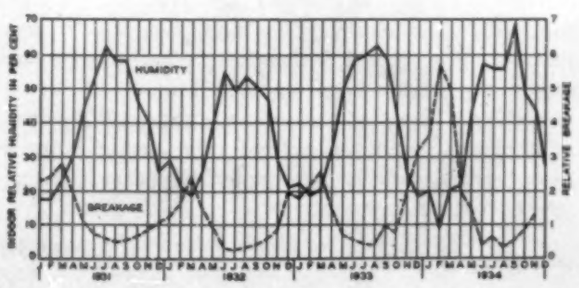

INDOOR RELATIVE HUMIDITY IN PER CENT
RELATIVE BREAKAGE
HUMIDITY
BREAKAGE
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1931
1932
1933
1934

FIG. 1.—Apparatus Breakage and Indoor Relative Humidity, New York City

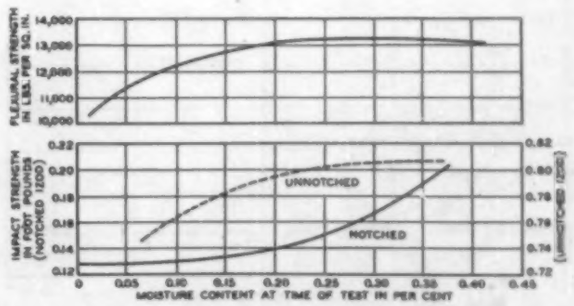


FIG. 2.—Effect of Moisture Content on Physical Properties of Phenol Plastic

improvements by the impact test has resulted in considerable reduction in breakage in service with substantial savings. For example in the case of the apparatus represented by Fig. 1 the reduction of relative breakage rate by improvement in impact properties is shown by Table II.

Effect of conditioning

Conditioning before test. The marked effect of moisture on the impact strength has been recognized by Committee D-9 and it has been found necessary to condition test bars prior to test to make possible a reasonable degree of reproducibility. Since the user of plastic materials is primarily interested in how the material will perform under adverse service conditions, various drying treatments were investigated and heating at 50°C. (120°F.) for 48 hr. was adopted. This treatment brings the specimen to a state comparable with the dryest it will be in normal indoor service and has been shown, by a comprehensive series of tests made by four laboratories, to erase or nullify the previous atmospheric history of the specimen. Other treatments such as exposure to low humidities at room temperature will also nullify previous history but such procedures are generally considered impracticable due to the long time necessary to produce satisfactory results.

The effect of conditioning on the notched Izod impact strength of phenol plastic, laminated phenolics, cellulose acetate and methacrylate resin is shown in Figs. 3, 4, 5, and 6, respectively. These data show the substantial effect of moisture, especially on the cellulose acetate, and also the length of time at 50°C. (120°F.) to bring them to a condition where reproducible values may be obtained. Examinations of the strength values before and after relatively long periods of heating at this temperature reveal no measurable effect on the material other than removing the moisture.

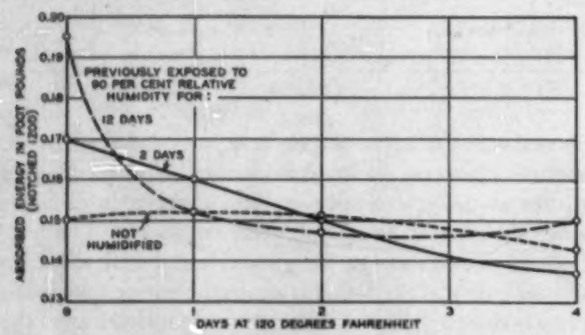

PREVIOUSLY EXPOSED TO 90 PER CENT RELATIVE HUMIDITY FOR:
12 DAYS
2 DAYS
NOT HUMIDIFIED
ABSORBED ENERGY IN FOOT POUNDS (NOTCHED 1200)
DAYS AT 120 DEGREES FAHRENHEIT

FIG. 3.—Eliminating the Effects of Previous History of Phenol Plastic by Exposure to 120°F.

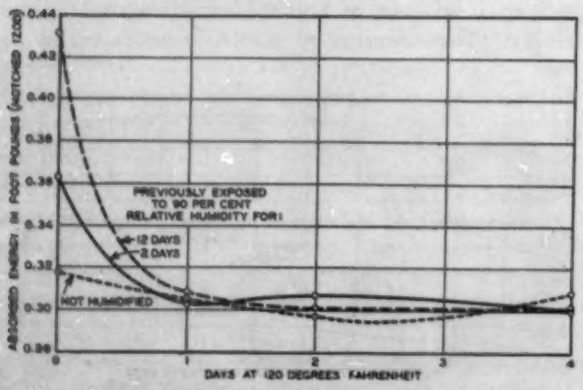

PREVIOUSLY EXPOSED TO 90 PER CENT RELATIVE HUMIDITY FOR:
12 DAYS
2 DAYS
NOT HUMIDIFIED
ABSORBED ENERGY IN FOOT POUNDS (NOTCHED 1200)
DAYS AT 120 DEGREES FAHRENHEIT

FIG. 4.—Eliminating the Effects of Previous History of Phenol Fiber (Laminated Phenolic) by Exposure to 120°F.

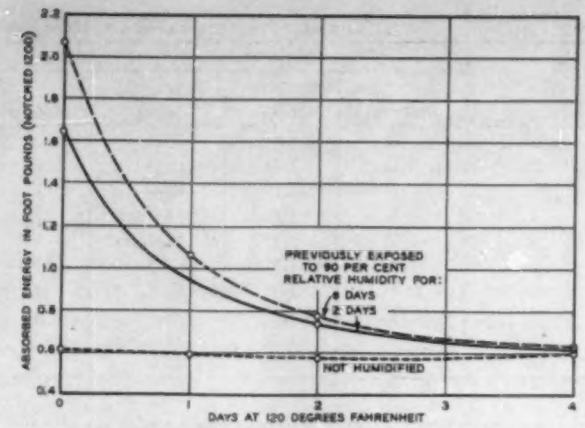

PREVIOUSLY EXPOSED TO 90 PER CENT RELATIVE HUMIDITY FOR:
6 DAYS
2 DAYS
NOT HUMIDIFIED
ABSORBED ENERGY IN FOOT POUNDS (NOTCHED 1200)
DAYS AT 120 DEGREES FAHRENHEIT

FIG. 5.—Eliminating the Effects of Previous History of Cellulose Acetate by Exposure to 120°F.

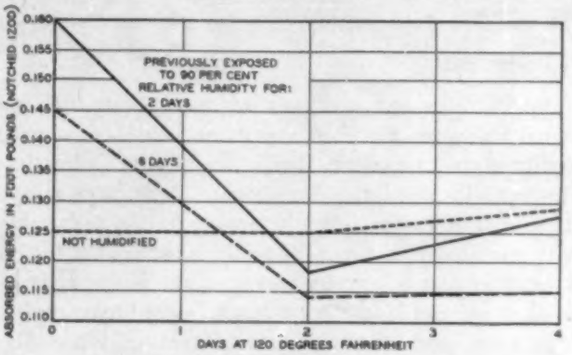

PREVIOUSLY EXPOSED TO 90 PER CENT RELATIVE HUMIDITY FOR:
2 DAYS
6 DAYS
NOT HUMIDIFIED
ABSORBED ENERGY IN FOOT POUNDS (NOTCHED 1200)
DAYS AT 120 DEGREES FAHRENHEIT

FIG. 6.—Eliminating the Effects of Previous History of Methacrylate Resin by Exposure to 120°F.

In the above tests the phenol fiber specimens were tested edgewise since this provides more consistent results than can be obtained with the flatwise break and indicates the minimum strength of the material.

Condition at test. Since the impact strength of the phenolics is not critical to those temperature variations normally encountered in the usual laboratory it has sufficed to permit testing at any convenient room temperature, the bars being broken immediately upon removal from the desiccator in which they have cooled. The situation is somewhat changed, however, for the thermoplastics which naturally are more responsive to temperature. Figs. 7 and 8 show the effect of temperature on the notched Izod, unnotched Izod and flexural strength of a commercial cellulose acetate and a methacrylate resin. Lack of a fixed relationship between flexural strength and impact strengths appears to characterize both these materials.

Inadequacy of single tests

In the early days of the plastics industry the phenol plastics were used most generally for applications where

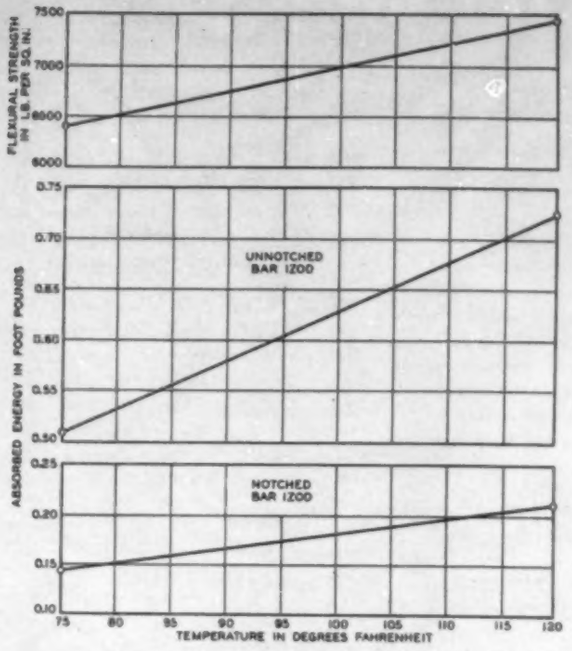


FIG. 7.—Effect of Temperature on the Notched-Bar Izod, Unnotched-Bar Izod, and Flexural Strength of a Commercial Cellulose Acetate

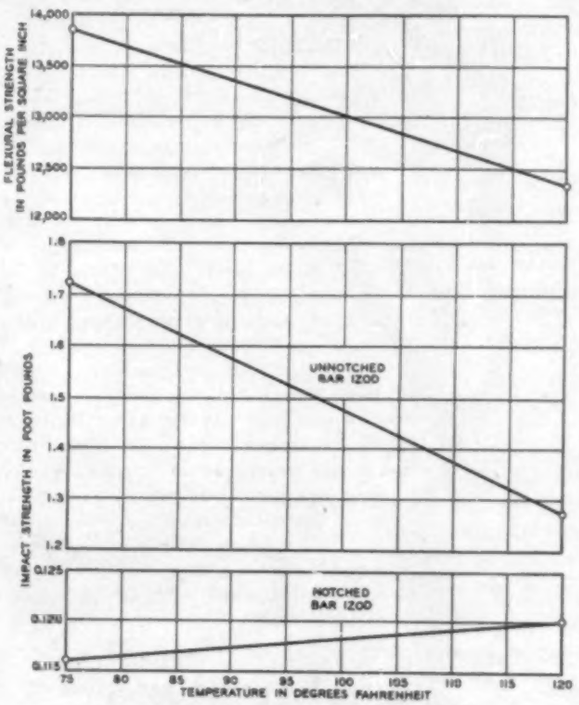


FIG. 8.—Effect of Temperature on the Notched-Bar Izod, Unnotched-Bar Izod, and Flexural Strength of Methacrylate Resin

physical or electrical properties were of paramount importance. Of the phenol plastics then available the product embodying approximately 50 percent resin and 50 percent woodflour was used almost exclusively. Into this relatively simple situation, comprising somewhat uniform resins, fillers and plasticity properties, a single impact test fitted surprisingly well for it was found that both the Charpy and Izod tests on $^1/_2$ by $^1/_2$ by 5 in. bars would predict the service strength of molded parts with reasonable accuracy.

FIG. 9.—Device for Making Laboratory Tests on Completed Telephone Apparatus

Table 2 gives data showing the relation between the notched bar Izod test and the strength of telephone apparatus as judged by tests on the completed apparatus and by field experience. Laboratory tests of the completed apparatus are made using the device shown in Fig. 9. This is a metal chute and anvil, and strength is measured by the height of fall at which break occurs in an increment drop test.

It was to be expected that this fortunate situation would not continue indefinitely. The use of mixtures of woodflour and cotton flock for applications requiring high-strength phenolics, the introduction of material of various plasticities to permit a wider assortment of molding techniques, and the increasing use of the thermoplastics for mechanical and electrical as well as decorative purposes, introduced into the plastics picture a group of mechanical proper- (*Please turn to page 52*)

TABLE 3. ILLUSTRATING THE LACK OF RELATION BETWEEN THE RESULTS OF ANY SINGLE IMPACT TEST ON STANDARD TEST SPECIMENS OF FOUR PHENOLIC MATERIALS AND RESULTS OF TESTS ON THE COMPLETED APPARATUS FABRICATED OF THE SAME MATERIAL

Material	Standard A. S. T. M. Notched-Bar Izod, ft-lb.	Unnotched - Bar Izod, (Standard A. S. T. M. Except Unnotched), ft-lb.	Increasing Blow Notched-Bar Izod, in.-lb.	Increasing Blow Unnotched-Bar Izod, in.-lb.	Unnotched-Bar Charpy, ft-lb.	Strength of Telephone Apparatus as Determined by Height of Fall Necessary to Break
A	0.247	0.829	1.5	6.3	1.145	60
B	0.189	0.735	1.1	6.3	1.035	60
C	0.235	0.584	1.4	5.0	0.925	45
D	0.140	0.619	1.0	6.2	0.971	30

PLASTICS DIGEST

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastic materials or use them

General

THE SEAWEED INDUSTRY AND THE POSSIBILITIES OF ITS REVIVAL. T. Dillon. Chem. and Ind. (London) *57*, 616–8 (June 25, 1938). Seaweed was of importance industrially in Great Britain 100 to 200 years ago as a source of alkali and iodine. Now the carbohydrate content is of more promise than the inorganic constituents. Alginic acid from seaweed is used as a dressing in the textile industry, as a clarifying agent in the sugar industry, and for preventing scale in boilers. It can be spun into a thread and its insoluble salts are useful as waterproofing agents. Boiled with alkalies it produces a hard plastic mass which can be pressed into sheets for wall and ceiling boards.

THE RISE OF THE PLASTICS INDUSTRY. Foster Sproxton. Chem. and Ind. (London) *57*, 607–16 (June 25, 1938). A review of the development of various commercial plastics.

CELLOPHANE IS BORN. A. P. Peck. Sci. American *158*, 274–5 (May 1938). An illustrated description of the steps involved in making cellophane.

Materials and manufacture

SOME POSSIBILITIES OF SHELLAC AS A MOULDING MATERIAL. A. J. Gibson. J. Soc. Chem. Ind. (London) *57*, 169–74 (May 1938). The behavior of lac when heat treated and compounded with accelerators and retarders is considered. The extraction of a hard lac resin with properties more suitable for a molding material is described. (See abstract, MODERN PLASTICS *15*, 52, Feb. 1938.)

SOME NEW POSSIBILITIES IN THE UTILIZATION OF ROSIN. G. F. Votz. Rev. Gén. Mat. Plastiques *14*, 134–9 (May 19, 1938). The treatment of rosin at 220–50° C. with a hydrogenating catalyst but without an external supply of hydrogen causes intra- and inter-molecular reactions resulting in products with improved properties, such as higher fusion point and lower oxygen affinity. Various possible applications of the materials in the paper, paint and varnish, and other industries are mentioned.

GENERAL PROPERTIES OF CELLULOSE DERIVATIVES. R. Bluma. Rev. Gén. Mat. Plastiques *14*, 126–134 (May 1938); 156–162 (June 1938). The effect of ultraviolet light from a mercury arc on cellulose nitrate films containing various plasticizers was studied. The optical and mechanical properties are not equally affected and the choice of plasticizer must therefore depend on which type of property is the more important in the intended application. The fabrication of cellulose nitrate and cellulose acetate plastics is described. Viscosities of cellulose triacetate and hydrolyzed cellulose acetate in methyl chloride-ethanol and acetone-water mixtures, respectively, are reported, and methods of examining various batches of these materials for uniformity of esterification by precipitation from such mixtures are outlined.

POLYSTYRENE. G. Daubenton. Rev. Gén. Mat. Plastiques *14*, 163–70 (June 1938). The preparation of styrene, its polymerization, and the properties and applications of the resin are considered in this article which is not complete in the one issue. Styrene can be prepared by thermal cracking of ethylbenzene, by dehydrohalogenation of the chlorides of ethylbenzene, by the dehydration of the phenylethyl alcohols, by heating cinnamic acid with barium hydroxide, and by synthesis from acetylene and benzene. Polymerization of the styrene thermally, catalytically, in an inert solvent, and emulsified in water is discussed.

Applications

GLUING OF WOOD WITH SYNTHETIC RESIN. O. Kraemer. Aircraft Engineering *10*, 183–6 (June 1938). Observed binding strengths in lb/in. of birch plywood glued with various substances and tested both dry and after immersion in water for 48 hours are as follows:

Binding Agent	Dry	Wet	Ratio Wet/Dry
Casein	540	213	0.4
Blood albumen	597	469	0.78
Phenolic resin (film)	697	540	0.78
Urea resin (liquid)	683	555	0.81
Phenolic resin (liquid)	825	725	0.88

The superiority of the synthetic resin glues is even more evident in resistance to weathering and fungus attack. Expanding applications of such water-resisting plywood are foreseen in the aircraft, ship-building, furniture, railroad, and other industries.

USE OF CELLULOID IN THE CONSTRUCTION OF APPARATUS. U. R. Evans and R. S. Thornhill. Chem. and Ind. (London) *57*, 693–5 (June 18, 1938). For many experiments on the corrosion of metals and for research in the field of electrochemistry generally straight-walled rectangular form apparatus not readily available in glass is frequently required. The authors describe methods for preparing such equipment from sheets of cellulose nitrate and cellulose acetate plastic. Paraffin wax is applied in the molten state with a brush to the inside of the containers before use.

FLEXIBLE FUEL- AND OIL-RESISTANT TUBING. A Weihe. Kunststoffe *28*, 139–40 (June 1938). Flexible tubing is made in Germany from olefin polysulfides, chloroprene, polyvinyl alcohol, and mixed vinyl polymers.

TOWARDS THE IDEAL DENTURE MATERIAL. Plastics (London) *2*, 200–1 (June 1938). A description of the technique and equipment used in dental laboratories in the molding of synthetic resin dentures.

THE PRINTED PICTURE. Plastics (London) *2*, 198–9 (June 1938). Plastic stereos are proving useful in the printing industry. They are light, thereby effecting economies in shipping charges, plant labor, and power costs. They are said to "accept" ink more easily than metal stereos, to be more durable, and to give equal sharpness and faithfulness of reproduction.

SYNTHETIC RESINS AS LACQUER RAW MATERIALS. A. Greth. Kunststoffe *28*, 129–39 (June 1938). A review covering unmodified and modified phenolics and alkyds, ureas, and polymeric resins of the coumarone, vinyl, and styrene types.

Chemistry

CATALYSTS IN PHENOL-FORMALDEHYDE CONDENSATIONS. II. N. J. L. Megson. J. Soc. Chem. Ind. (London) *57*, 189–97 (June 1938). The resinification time (R. T.) of condensations of phenols with formaldehyde is defined as the time taken from initial heating of the clear solutions to the appearance of permanent turbidity, and is of particular importance in condensations of mixed phenols (see MODERN PLASTICS *14*, 38, Feb. 1937). R. T. is dependent on the nature, solubility, and proportion of phenols, constitution of formalin, nature and quantity of catalysts, and solubility of condensation products. The catalytic activity of alkylamines (excluding tertiary amines) is directly proportional to the number of alkyl substituents, but inversely proportional to their size. The effectiveness of acid catalysts is closely related to the dissociation constants of the acids, the acids studied falling in the following order of decreasing activity: hydrochloric, nitric, sulfuric, trichloroacetic, oxalic, phosphoric, dichloroacetic, chloroacetic, formic, lactic, acetic.

Test methods and results

MEASUREMENT OF HIGH INSULATING RESISTANCES OF PLASTICS. F. Weidmann. Kunststoffe *28*, 141–3 (June 1938). Diagrams are shown for apparatus to measure resistances up to 10^{18} ohms using a Wheatstone bridge and a sensitive electrometer as a null point indicator.

DIELECTRIC PROPERTIES OF DYED CELLULOSE TRIACETATE FILMS. G. Pfestorf and W. Hetzel. Kunststoffe *28*, 144–5 (June 1938). The power factors and dielectric constants of colored triacetate films over the temperature range −40° to 140° C. are reported.

Tenite gives the electric razor a new "edge"

Injection-molded parts by Gits Molding Corp. for Match King, Inc.

TENITE IS THE FIRST PLASTIC ever to be used for a shaver head . . . the comb-like cutting end of an electric razor. Four heads, plus four discs, are injection-molded in only one operation.

Tenite gives the shaver head low heat conductivity . . . provides a shaving surface pleasantly warm to the skin . . . adds lustrous color as a final sales appeal.

These parts are molded of Tenite faster than they can be die-cast or machined of any other material. The use of Tenite has, in the same way, cut manufacturing and assembly costs of hundreds of other products.

Tenite is a tough, practically unbreakable plastic made of Eastman cellulose acetate, in all colors. Its uses are described in a 52-page illustrated book which will be sent on request.

TENITE REPRESENTATIVES: New York: 10 East 40th Street; Chicago: 2264 Builders Building; Detroit: 914 Stephenson Building; Leominster, Massachusetts: 39 Main Street; Pacific Coast: W. & G. Meyer & Company, San Francisco: Federal Reserve Building; Los Angeles: 2461 Hunter Street; Seattle: 710 Belmont Place.

TENITE

An Eastman Plastic

TENNESSEE EASTMAN CORP., Subsidiary of the Eastman Kodak Co., KINGSPORT, TENN.

U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

OLEFIN RESINS. F. E. Frey and P. A. Bury (to Phillips Petroleum Co.). U. S. 2,118,813, May 31. Catalysts for the sulphur dioxide-olefin method of making resins are prepared by impregnating a fibrous filler with the catalyst material.

INSULATED WIRE. E. H. Converse (to Jas. K. Delano). U. S. 2,118,838, May 31. A new insulating composition comprising a cellulose ester and a furfural resin.

VINYL POLYMERS. W. Reppe, W. Starck and A. Voss (to I. G. Farbenindustrie A.-G.). U. S. 2,118,863, 2,118,864, 2,118,945 and 2,118,946, May 31. Making resins by interpolymerizing mixtures of vinyl caproate, caprate, valerate or like esters with styrene, vinyl chloride or acrylic acid or an acrylic acid derivative.

DIPENTENE RESINS. I. W. Humphrey (to Hercules Powder Co.). U. S. 2,118,925, and 2,118,926, May 31. Making new resinous products by condensing dipentene with maleic anhydride, with or without a polyhydric alcohol and a resin acid.

ADHESIVE TAPE. O. Herrmann and P. Müller (to Kalle & Co. A.-G.). U. S. 2,119,163, May 31. A roll of adhesive tape is made of moisture-sensitive cellulose derivative coated with a plastic adhesive and protected by air-excluding disks of foil.

CAN SEALS. A. L. Kronquest and S. C. Robison (to Continental Can Co.). U. S. 2,119,280, May 31. A composition of chloroprene, alkyd resin, drying oil gel and ester gum, used in aqueous dispersion for sealing cans.

INSULATING TAPE. PAUL NOWAK (to General Electric Co.). U. S. 2,119,400, May 31. A polymerized acrylic acid derivative is used as binder and adhesive for textile insulating tape, rendered heat-resistant with a filler composed of powdered quartz.

VARNISH RESIN. Paul Michaut. U. S. 2,119,466, May 31. Making urea-formaldehyde resins in presence of alcohol and inert dispersing agent, removing the dispersing agent and dehydrating the product in presence of acetanilide to make a varnish resin.

RUBBER DERIVATIVE. P. M. Clark (to E. I. du Pont de Nemours and Co.). U. S. 2,119,507, May 31. Compounding a polymerized polycyclic hydrocarbon with the resinous product formed by treating rubber with chlorine, hydrogen chloride or an amphoteric metal chloride.

COATED PAPER. P. S. Barnhart (to Westfield River Paper Co.). U. S. 2,119,508, and 2,119,509, June 7. A flowable coating for paper contains chlorinated rubber, ester gum, coumarone resin, paraffin and a plasticizer.

LABELS ON GLASS. D. W. Knaggs (to Anigraphic Process, Inc.). U. S. 2,119,546, June 7. Printing on bottles with a fast-drying hard-setting ink, covering the ink with a synthetic resin varnish and baking at 300° F.

CELLULOSE ESTER FOIL. H. B. Smith (to Eastman Kodak Co.). U. S. 2,119,722, June 7. Transparent foil composed of 100 parts of a highly esterified cellulose acetate-propionate plasticized with 10-50 parts of a lower alkyl ricinoleate.

PHOTOGRAPHIC FILM. C. J. Staud (to Eastman Kodak Co.). U. S. 2,119,724, June 7. Reducing contrast in photographic films by coating the film with a water-permeable cellulose ester containing monoacetin to facilitate penetration by the developer.

HYDROCARBON RESINS. T. F. Nealon (to Monsanto Chemical Co.). U. S. 2,119,957, June 7. In polymerizing petroleum unsaturates to resinous products the aluminum chloride catalyst is neutralized with a lime slurry in aqueous alcohol or acetone.

VARNISH RESIN. I. V. Wilson (to Monsanto Chemical Co.). U. S. 2,119,976, June 7. Making varnish resins by polymerization of petroleum unsaturates with high diolefin content.

METHACRYLATE RESIN. D. E. Strain (to E. I. du Pont de Nemours and Co.). U. S. 2,120,006, June 7. Molding a mixture of polymerized and unpolymerized methacrylate ester under pressure at a temperature such as to polymerize the unpolymerized portion.

ROSIN POLYMERIZATION. J. N. Borglin (to Hercules Powder Co.). U. S. 2,120,015, June 7. Simultaneous refining and polymerization of rosin by treatment with boron trifluoride in a solvent.

LAMINATED FABRIC. R. M. Freydberg (to Acme Backing Corp.). U. S. 2,120,054, June 7. A thermoplastic adhesive for joining fabric plies is made of 100 parts methacrylate resin, 1 part chlorinated rubber and 10 parts dibutyl phthalate.

LACQUERS. E. F. Arnold and M. J. Callahan; P. B. Cochran and R. T. Hucks (to E. I. du Pont de Nemours and Co.). U. S. 2,120,083, and 2,120,089, June 7. Nitrocellulose lacquers containing a solid gelled nondrying oil dispersed in alcohol and ethyl acetate.

INSULATED CABLE. J. W. Greenleaf (to Rockbestos Products Corp.). U. S. 2,120,095, June 7. Insulating wire with alternate layers of thin chlorinated rubber and felted asbestos, the asbestos fibers being partially embedded in the chlorinated rubber.

VARNISHES. Wm. H. Butler (to Bakelite Corp.). U. S. 2,120,124, June 7. Blending an oil-soluble heat-reactive phenol-aldehyde resin (2 parts) with from 1 to 40 parts of a blown oil.

FLAMEPROOF PLASTIC. W. D. Spencer and F. T. Walker (to Imperial Chemical Industries, Ltd.). U. S. 2,120,222, June 7. Compounding chlorinated rubber with chlorinated paraffin to make a nonflammable plastic composition.

LIGHTFAST LACQUER. W. D. Bowlby (to Egyptian Lacquer Mfg. Co.). U. S. 2,120,236, June 14. Nitrostarch, plasticized with a blend of a liquid and a solid plasticizer, in lacquers which are not discolored by the actinic rays of light.

REFINING RESINS. Isidore G. Wolf. U. S. 2,120,343, June 14. Dissolving a phenol-aldehyde resin, adding the solution to a washing liquid, and evaporating the solvent from the washing liquid in such proportion that the resin is precipitated in finely divided form.

ELECTROLYTIC CONDENSER. W. Herrmann (to Radio Patents Corp.). U. S. 2,120,426, June 14. Placing a layer of viscose sponge between condenser electrodes to hold absorbed electrolyte.

RESIN POWDER. T. W. Dike (to I. F. Laucks, Inc.). U. S. 2,120,549, June 14. Forming thermoplastic powdered resins from their solutions or suspensions in water by spray drying, and coating the particles with a powder to prevent agglomeration.

GOLF BALL COVER. J. A. Merrill (to Wingfoot Corp.). U. S. 2,120,567, June 14. A rubber derivative made by action of water on a reaction product from rubber and chlorostannic acid is used as an ingredient in golf ball covers.

"If I were an ADVERTISING MANAGER"

That's just one of the talks to be delivered anonymously by a masked speaker that will set every man thinking at the Annual Conference of National Industrial Advertisers Association in Cleveland, September 21-23. A second masked speaker will tell what he would do if he were a publication representative.

We're not going to tell you much here—just highlight the program enough to make your mouth water and your brain tingle.

T. M. Girdler, Chairman, Republic Steel Corporation, is scheduled for the opening address and when "T. M." talks he says something.

J. H. McGraw, Jr. will talk on "What I Would Do *Now* If I Were An Industrial Advertising Manager."

The new Publisher's Statement will receive full discussion.

Clinic sessions, so popular last year, will again cover a wide range of interesting subjects. Two half-day sessions instead of one.

A general conference session will cover such subjects as "Preparing the Plan", "How to Gather Usable Material", "Copy Technique", "How to Sell Management", "Co-ordinating Sales and Advertising" and "How and Why to Use an Industrial Agency."

Another session will deal with "Problems of the Small Advertiser", "Production Problems", "Public Relations"—and there are many others.

If I were an Advertising Manager, I certainly would start now to make plans to attend the 16th N. I. A. A. Conference even if I had to hitch-hike to Cleveland. And I would send in my advance registration now to—Ed. Bossart, Bailey Meter Company, Ivanhoe Road, Cleveland, Ohio.

IF I EMPLOYED AN ADVERTISING MANAGER—I would make certain that he attended this Conference, because changing times and markets demand a changed viewpoint—a new viewpoint that can be obtained only by hearing discussions by men whose experience is up-to-the-minute—right up to September 21st.

NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION

100 EAST OHIO STREET • CHICAGO, ILLINOIS

NEWS

William S. Murray closing the laboratory digester in which an experimental batch of his new plastics is being made

ABOUT THREE MONTHS AGO, NEWSPAPERS ANNOUNCED that William S. Murray, chairman of the Republican State Committee, had disclosed "his invention of a new plastic which may utilize a large portion of the nation's surplus milk." Since that time, many inquiries have come to us asking how this new plastic differs from the well-known product, casein. Rather than try to draw a comparison between the two materials, let us tell you in Mr. Murray's own words just what his product is and how its discovery came about.

For a good many years, Mr. Murray has been engaged in chemical research in the vicinity of Utica, N. Y., and maintains a laboratory under the name, William S. Murray, Inc., 805 Watson Place. Among his clients is a century-old tanning company which in the spring of 1932 was ordered closed by the Conservation Commission because the tannery was polluting a nearby stream. The polution was caused by the geletinous waste involved in tanning. Mr. Murray obtained a thirty-day stay and promptly worked out an acid treatment which solidified the waste so it could not harm the stream.

"This set me to thinking," says Mr. Murray, "about all the waste milk in that vicinity which is the by-product of the milk powder industry which uses the cream, and discards the skimmed milk. I wondered if that, too, couldn't be solidified and put to some useful purpose in the plastic field. It is a known fact that casein is separated by treating skimmed milk with a weak acid which throws the casein out of solution. Then it is washed, dried and formed into rods or sheets and hardened with formaldehyde, an expensive process which keeps the cost high.

"Now my thought was to try to change the natural milk sugar to aldehyde by chemical reaction in the presence of casein which would avoid the curing or hardening process and reduce the cost. I explored that very carefully and finally found that I was able to do it. And I also found that under those conditions of treatment, I was getting a molding powder that was stable after pressing."

The process is simple, requiring but two pieces of apparatus, a digester and dryer. All the elements including woodflour or other filler are put in the digester where they are treated and stirred for 15 to 25 minutes. When dried in an ordinary rotary dryer, the product is removed in the form of powder capable of molding in any hydraulic press.

The product when molded appears much like phenolics, dark colors alone have been produced. It is fully described in U S. Patent No. 2,115,316, granted April 26, 1938, assigned to Dairymen s League Co-Operative Association, Inc.

Mr. Murray says he believes the plastic will be used in making heavy pieces such as cases, cabinets, housings, even caskets, where other plastics would be too costly. Since the principal ingredient is a waste product which already contains its own hardening agent, and since the process is extremely simple, the greatest cost of the product is in labor and the acids used in the chemical reaction.

We called the Dairymen's League on the telephone to ask what, if anything, was being done about putting the material into production. The answer was: "Nothing, yet, but we expect to license the process on a royalty basis eventually and are willing to listen to any proposition."

COMMITTEE D-20 ON PLASTICS OF THE AMERICAN SOCIETY for Testing Materials met on June 30 and July 1 at Atlantic City, N. J., during the Forty-First Annual Meeting of the Society. Approximately 35 of the 45 members of the committee were present. The various activities of the five subcommittees may be summarized as follows.

Subcommittee I on Strength Properties has organized two sections which are actively engaged in studies of methods of measuring flexural and tensile strength, and methods of measuring resistance to impact. Subcommittee II on Hardness Properties is working on the development of methods for measuring indentation hardness, abrasion resistance, cold flow and machinability, each being in charge of a section of the subcommittee. Subcommittee III on Thermal Properties has projects underway covering test methods for distortion under heat, thermal expansion, thermal conductivity, flammability, and plasticity of both thermoplastic and thermosetting materials. Subcommittee IV on Optical Properties has established sections to work on index of refractions, surface irregularities, haze and optical efficiency. A proposed method for measuring the index of refraction of plastics has been prepared for submission to a letter ballot of the subcommittee members. Subcommittee V on Permanence Properties has four sections to develop methods for determining the effects of various chemical and physical agents on plastics, as follows: light, heat, water and chemical reagents. Drafts of methods for determining the effect of chemical reagents on plastics and for measuring the absorption of water by plastics have been prepared for submission to the members of the subcommittee for ballot.

A paper on "The Impact Testing of Plastics" by R. Burns and W. W. Werring was presented as part of the Symposium on Impact Testing on June 28. Various members of the Society in discussing this paper congratulated the authors on their pioneering accomplishments in this difficult testing field. Some remarkable motion pictures taken at the rate of 2000 exposures per second were shown to illustrate the impact breakage of plastics test specimens. The paper by Burns and Werring is published elsewhere in this issue.

RESINOX CORPORATION ANNOUNCES THE REMOVAL OF their offices to 17 Battery Place, New York. The company was formerly located at 230 Park Avenue.

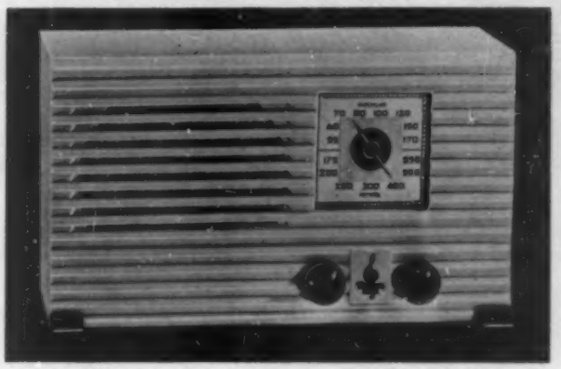
THE NEW VINYL ACETATE RESIN PLANT OF SHAWINIGAN Resins Corporation has been completed and production on a regular schedule will get under way immediately, it was announced recently. Shawinigan is jointly owned by Monsanto Chemical Co., St. Louis, and Shawinigan Chemicals, Ltd., Montreal.

Vinyl acetate sheets for use by glass and motor car manufacturers in a new type of safety glass for automobiles, railroad cars and other vehicles will be the principal product of the plant. Vinyl acetate binder for glass is expected to replace rapidly the present cellulose acetate binder and to improve the glass to such an extent that safety will be greatly increased.

THE NEW YORK GIFT SHOW WILL BE HELD AT THE HOTEL Pennsylvania, New York City, during the week of August 22–26 under the George F. Little Management.

THE FOURTH ANNUAL ATLANTIC COAST PREMIUM EXPOSITION will be held September 12th to 16th in the Grand Ballroom of the Hotel Astor, New York City.

BEGINNING...1939!!



July is January to Associated Attleboro. Already we are ringing in the new year, hard at work on the 1939 models for leading plastic users.

We have just completed these two distinctive 1939 Emerson cabinets . . . two of a long line of Emerson housings turned out by us during the past years. Manufactured of different materials, different in style and size, they both incorporate one single standard of fine workmanship, efficiency in production and uncommon economy.

If you are contemplating a plastic product for 1939—bring it to the molder who is already in full stride for 1939 production . . . six months ahead of the market, and miles ahead of others in the field.

ASSOCIATED ATTLEBORO MANUFACTURERS, INC.

ATTLEBORO, MASS.

HELIOGEN BLUE B POWDER

WITH COLORLESS PLASTICS PRODUCES BRILLIANT BLUES OF EXCELLENT LIGHT FASTNESS

GDC

GENERAL DYESTUFF CORPORATION

435 HUDSON STREET, NEW YORK, N. Y.

NEWS

Lucite reflectors reduce night accidents on Highway U.S. 16 between Lansing and Detroit, Michigan

CHECKING UP WITH THE MICHIGAN STATE HIGHWAY COMmissioner to learn the results of the Lucite Reflectors installed by the Signal Service Corporation on Highway U. S. 16 between Lansing and Detroit announced in our May issue, the following telegram has been received: NIGHT ACCIDENTS US-SIXTEEN LANSING TO DETROIT DECLINED SEVENTY NINE PERCENT APRIL SIX TO JULY SIX COMPARED WITH SAME PERIOD YEAR AGO stop EFFECTIVENESS OF REFLECTORS SHOWN BY FACT THAT DAYTIME ACCIDENTS DECLINED ONLY THIRTY SEVEN FIVE TENTHS PERCENT SAME PERIOD stop NINE NIGHT ACCIDENTS RECORDED THIS THREE MONTH PERIOD THIS YEAR COMPARED WITH FORTY THREE NIGHT ACCIDENTS SAME PERIOD YEAR AGO stop NO FATAL ACCIDENTS AT NIGHT SAME PERIOD THIS YEAR COMPARED WITH FOUR LAST YEAR stop FEEL FREE TO USE THESE STATISTICS GATHERED BY MICHIGAN STATE POLICE TO BEST ADVANTAGE. (Signed) MURRAY D. VAN WAGONER STATE HIGHWAY COMMISSIONER.

THE 'TRIUMPH' HOLDER FOR LIGHT MARKING OF PRODUCTS made from plastics, metal, wood, or fiber is announced by Matthews Co. From 1 to 8 movable characters may be set in the holder at one time. A light tap with a hammer stamps their impression.

A NEW CHROME LACQUER BASED ON A METHACRYLATE composition similar to Lucite, but in liquid form, which is colorless, hard, tough, elastic and resistant to sunlight, has been announced by the du Pont Company. Its most notable characteristics are transparency, adherence to metals, quick drying properties and durability. When applied to metal it drys in fifteen minutes, forming an invisible film over the surface. It is claimed the lacquer will not chip or peel, nor will it affect the color and gloss of the metal to which it is applied.

The chromium parts of automobiles are exposed to rain and snow, and such exposure causes rust formation on bumpers, radiator shells, hub caps, etc. The new lacquer applied to the metal will protect the chrome from rusting, and from the corrosive action of salt air. Calcium chloride is used on many dirt roads to settle the dust. This chemical is also damaging to the chromium; however, if the new lacquer is applied, it will give the needed protection to the metal. Boat owners, too, will find the new lacquer effective in protecting brass, chrome and nickel-plated fixtures from the rust and corrosion caused by salt spray, fog and moisture.

Other typical applications include building hardware, bronze bank fixtures, name plates, railings, bicycles, mail boxes, store fixtures, etc. Chrome lacquer may also be used on metal articles which are not exposed outdoors, but which nevertheless are subject to tarnish and discoloration. Brass candlesticks, bronze statuettes, trophies, loving cups, and such, can be kept bright through the use of this lacquer.

THAT APPLICATIONS OF RUBBER AND PLASTICS ARE RAPIDLY forging ahead is clearly evident from the attention now being devoted to these materials. Indicative of the trend, the American Society of Mechanical Engineers recently established a committee, or subdivision, on rubber and plastics which will deal with several phases of the rubber and plastics industries including mechanical applications, research on basic mechanical properties, processing equipment, and standards. Activities of the group will be beyond the normal range of other professional organizations in an effort to fill the present conspicuous gap in the mechanical field.

The meeting will sponsor the presentation of papers at technical sessions of the regular quarterly meetings of the A.S.M.E. A symposium on rubber comprising four invited papers covering the history of rubber, synthetic substances with rubber-like properties, fabrication of rubber parts, and certain mechanical properties of rubber is included in the program of the next meeting of the society to be held at Providence, October 5–7. Participation in activities of the committee will not be restricted to members of the parent society.

Authors of papers believed suitable for presentation at subsequent quarterly meetings should communicate at least four months in advance with Dr. J. F. Smith, Edward G. Budd Mfg. Co., 25th St. and Hunting Park Ave., Philadelphia, Pa., secretary of the rubber and plastics committee; or with the chairman, Dr. F. L. Yerzley, E. I. du Pont de Nemours & Co., Inc., P. O. Box 525, Wilmington, Del.

EARL SIMONDS, FOR THE PAST TWO YEARS A PLASTICS CONsultant with offices in New York City, has become associated with the rapidly growing business of Paul Norris at Wellston, Ohio. This company announces also that William Robert Wilson and D. E. Baskerville have been appointed representatives to service the automotive industry with offices at 6460 Kercheval Ave., Detroit.

THE PAYSON COMPANY HAS WORKED OUT A METHOD OF spraying flock on to the surface of any plastic which gives it the appearance of being covered with felt. The economies are obvious since felt would have to be cut and fitted by hand and the flocking process is reputed to cost from 30 to 40 percent less than such felting for bases. Flocking can be applied to any flat surface of almost any material, it is reported, and some interesting samples are being shown. The process seems to have considerable merit for putting bases on ring boxes and other packaging items to prevent them from scratching.

ILLINOIS TESTING LABORATORIES, INC., ANNOUNCES THAT they have developed a new type shock-proof portable pyrometer. Its essential features consist of a spring suspended movement within the case to minimize shocks and jars, shock-resisting movement with pivots and jewels especially designed for unusually severe service, new

type pointer lock to damp the movement of the instrument when carried or transported, unusually heavy metal case to prevent breakage if dropped, shatter-proof glass and a scale length of 5 inches.

FREDERICK W. JOHN, APPLICATION ENGINEER, PLASTICS Dept., General Electric Co., has moved his activities from Pittsfield, Mass., to the General Electric Building, New York City, for the greater convenience of those clients served in that territory.

SYMBOLIC OF THE NATIONAL IMPORTANCE OF PLASTICS IN Germany, a new Plastics Institute has been established at Frankfort-on-Main, principal center of the German chemical industry. A new building near the Frankfort University is now in course of construction which will house the Plastics Institute. In addition to being provided with laboratories and other rooms necessary for conducting scientific research work regarding plastics, the Institute will contain a permanent exhibition of plastic materials and processing apparatus which will be kept up-to-date with latest scientific and commercial advances in the sphere of plastics.

The nucleus of the exhibition was provided by the extensive exhibits of plastics at the "Achema" chemical equipment exposition held at the fair grounds in Frankfort in 1937 and which were generally considered as the most successful and interesting and most discussed section of the entire exposition. (American Consulate General, Frankfort-on-Main.)

WE HAVE OFTEN WONDERED ABOUT THE WESTINGHOUSE elevators in the General Electric Company's Building at 570 Lexington Ave., New York, but became reconciled recently when we visited the Westinghouse plant at East Pittsburgh and saw the executive offices being swept with a Hoover vacuum cleaner.

GILBERT ROHDÉ IS WORRYING ABOUT WHAT BECOMES OF Industrial Designers when they get old. He feels that the first crop will mature shortly after the opening of the New York World's Fair in April 1939.

THE THIRD ANNUAL CONVENTION OF THE WESTERN SECTION of the S.P.I. opened formally Monday, June 27, at Spink Hotel, Lake Wawasee, Indiana. The attendance registered close to 70 members.

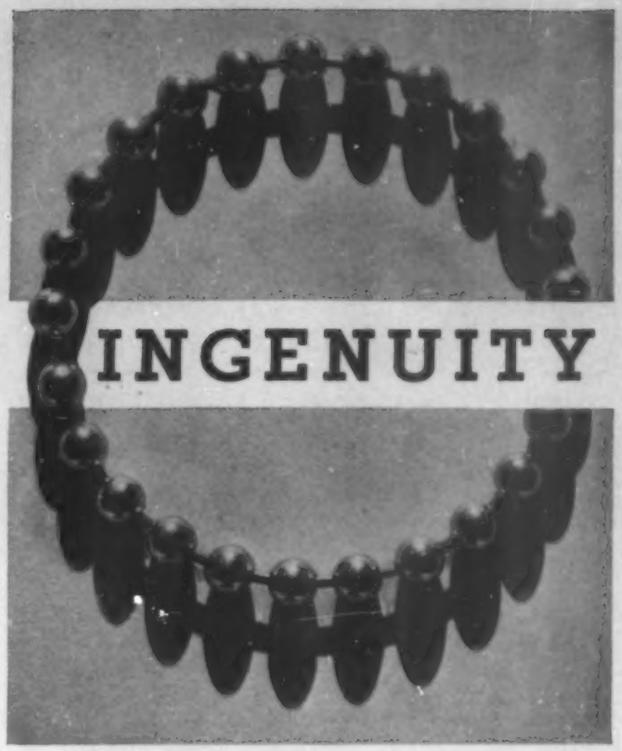
Monday evening the banquet was presided over by Alan Fritzsche. Bill Kelly, secretary, read the minutes of the previous meeting at Shawnee as well as the minutes of the Sectional and Directors meetings.

This convention marked the first meeting of the Western Section which was thrown open for general discussion. Posted in the lobby of the hotel was a general letter signed by W. L. Kelly, secretary, inviting members to bring up for discussion whatever problems they had in mind and such problems would be incorporated in a resolution and submitted to the Board of Directors for their consideration.

Immediately after the banquet, Mr. Fritzsche introduced L. L. Putnam, certified public accountant, who gave a brief discussion on the subject of trade associations and their importance to the industry. He reviewed briefly various industries making headway through trade co-operation and pointed out specific industries such as California canning organizations and others.

Those attending included: R. Alden, C. H. Allin, L. H. Amrine, R. A. Amrine, E. L. Anderson, K. N. Atwater, C. J. Blackwell, E. F. Bachner, J. J. Bachner, J. J. Bauman, R. E. Blanchard, C. W. Blount, R. E. Brannan, J. N. Brown, Albert Bryan, Bob Campbell, G. W. Carpenter, Jim Connors, P. DeHan, F. J. Donohue, C. Ellis, Jr., Chas. Frantz, Ted Friberg, A. W. Fritzsche, A. M. Gibson, A. W. Hanmer, Jr., R. B. Harrison, W. B. Hoey, S. Holmgren, G. A. Johns, H. J. Kasch, Jr., H. J. Kasch, Sr., W. L. Kelly, C. H. Kitchen, Chas. Lichtenberg, W. B. Longacre, Garland Lufkin, Fred Luther, Jr., Harry McGowan, Mr. and Mrs. M. M. Makeever, J. S. Miller, Elmer E. Mills, Mr. and Mrs. F. H. Morelock, S. T. Moreland, C. M. Phillips, D. S. Plume, L. L. Putnam, L. M. Rohden, F. C. Rowley, Frank Shaw, W. N. Shepard, Wm. G. Skutch, H. S. Spencer, Wm. F. Torres, D. O. Van Ness, G. W. Wilcox, Ed Weichmann, W. A. Weymouth, D. G. Wilson.

WE NEGLECTED TO MENTION THAT THE TRANSPARENT OIL cans illustrated on page 58, July issue, are completely molded of Lumarith, a cellulose acetate material.



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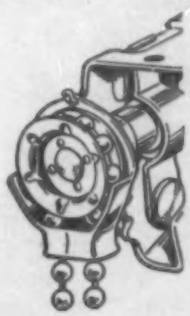

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PUBLICATIONS

Booklets reviewed in these columns will be sent without charge to executives who write for them on their company letterheads. Other books will be sent postpaid at the publishers' advertised prices

Chemistry and Technology of Rubber Latex

by C. Falconer Flint

Published by D. Van Nostrand Co., New York

Price $14.00 **735 pages, 146 illustrations**

The author is well qualified to prepare a comprehensive text on latex since he was formerly of the Rubber Research Institute of Malaya and is now on the staff of Imperial Chemicals, Ltd., in charge of research and development work on latex technology. This book was originally planned as a translation of the French text by Georges Genin which was published in 1934, but developments in the use of latex have been so numerous and rapid that essentially a new book was compiled. Every effort was made to bring the work up to the very date of publication; several pages of notes were added to cover the interval between the preparation of the manuscript and the printing of the book.

The contents include 12 chapters which deal with the following subjects pertaining to latex: History, Source, Composition and properties, Coagulation and preparation of rubber, Preservation, shipping and concentration, Compounding and vulcanization, Manufacture of dipped goods, Electrodeposition, Impregnation of fibers and fabrics, Other applications, Physical testing, and Artificial dispersions of rubber. The volume of the literature on latex is indicated by the fact that the book contains 1330 references to scientific and technical publications and patents. The author is well aware of the limitations of patents as sources of useful information but of necessity turns to them for the description of many applications which are not treated elsewhere.

Workers in the field of plastics may find considerable material of interest in this broad, thorough treatment of a related field. Consideration is given, for example, to various products such as coated and impregnated fabrics, electrical insulation, brake lining, protective coatings, adhesives, and artificial leather in the production of which rubber latex competes with plastics. Rubber molds for plastics are not discussed as such, but basic information is given which will be of direct use to anyone interested in their production. A survey is given of methods for making powdered rubber to be molded in a manner similar to plastics. (A. T. McPherson, Chief Rubber Section, U. S. Dept. of Commerce, National Bureau of Standards.)

Industrial Chemistry

by Emil Raymond Riegel

Reinhold Publishing Corporation, New York, 1937, 3rd Edition

Price $5.75 **851 pages, 275 illustrations**

This is an elementary treatise for the student and general reader on the manufacture of chemical products. Its fifty chapters cover such diverse materials as acids and alkalies, glass, fuels, cellulose and its derivatives, dyes, paints, explosives, leather, rubber, metals, plastics, and many others. The equipment commonly employed in chemical plant operations is described in detail. An ample index and plenty of cross references throughout the text make the work a handy source of information on chemical technology.

A STUDY OF WETTING AGENTS AND THE FACTORS CONTRIButing to their activity with special reference to Triton W-30 has been published by Röhm and Haas Company, Inc. It is claimed that the use of Triton W-30 as a general wetting agent for textile mill problems insures the production of goods whose innermost pores, cells, and capillaries are penetrated by scouring agents, dyestuffs, and finishing oils or gums. It also is reported to insure an even, rapid application of these materials and the production of brighter, clearer, and more attractive goods. Graphs and tables illustrate activities and effects of the new material. This 40-page booklet is available upon request.

CARBIDE AND CARBON CHEMICALS CORP. ANNOUNCES THE ninth edition of Synthetic Organic Chemicals. This 80-page book contains specifications, properties, and uses of its 105 industrial organic chemicals. The properties of 29 new chemicals which have become commercially available since the last issue of this catalog are included, as well as a complete new section on "Tergitol" penetrants. The solubility table has been augmented to include data on 71 solvents, and a new column indicating their solvent power for rubber has been inserted.

IN THE JUNE-JULY ISSUE OF MONSANTO CURRENT EVENTS, there is an illustrated story showing how golf tees are made from rod stock Fiberloid. By making them in two parts for rapid assembly, golf tees may be made this way to compete favorably with injection molded golf tees. The rods from which the shafts are made are ground to size on a centerless grinder while the heads are cut on an automatic slicing machine. Very little hand work is required for finishing and assembling. Two color effects are readily available.

TRADE PROMOTION SERIES—NO. 177 OF WORLD CHEMICAL Developments in 1937, is now available from the Superintendent of Documents, Washington, D. C. This bulletin has been prepared from reports submitted by the foreign offices of the Department of Commerce and of the Department of State and from official data and statistics supplied to the Department by the various foreign countries. The cost is 25c per copy.

NATIONAL VULCANIZED FIBRE CO., RECENTLY ISSUED A 33-page booklet describing 'Phenolite,' a phenolic laminated material, easily adaptable to applications for the electrical, automotive and aeronautical, textile, radio and television, and other various industries.

GENERAL PLASTICS, INC., HAS ISSUED A 4-PAGE SUPPLEMENT to their recently published booklet on Molded Durez for Table Radio Cabinets, which includes new radio cabinet assemblies, and plastic parts.

"SYNTHETIC RESINS APPLIED TO TEXTILES" IS A SYMPOSIUM of articles written by Dr. D. H. Powers of Röhm and Haas Company, Inc., which has been reprinted from *American Dyestuff Reporter*, *Rayon Textile Monthly* and MODERN PLASTICS by R & H Co.

BULLETIN NO. 38, DESCRIBING THEIR LABORATORY MILL has recently been issued by the Raymond Pulverizer Division of the Combustion Engineering Co., Inc. The mill is particularly adapted for test grinding and development work.

THE BRITISH XYLONITE CO., LTD., RECENTLY PUBLISHED A 23-page booklet describing Bexoid molding powder, a thermoplastic material. The booklet contains many illustrations including injection molding presses, molded items and blueprints.

BAKER & ADAMSON DIVISION OF GENERAL CHEMICAL CO. have recently released a 258-page spiral bound catalog with transparent plastic covers. Various grades of the company's chemicals are described and everything, well nearly everything, from acids and ammonia to zinc sulfide are included.

THE CLEVELAND PNEUMATIC TOOL CORP. HAS RECENTLY issued Bulletin "L" relating to their new No. 9 Series of Rotary Air Drills, Grinders, Screw Drivers, and Nut Setters.

W. W. SLY MANUFACTURING CO., ANNOUNCES 2 NEW BULLEtins, Nos. 90 and 91, copies of which are available upon request. No. 90 is a recent revision of their previous bulletin on cloth type dust filter equipment and No. 91 is an entirely new one which covers their "Centri-Merge" wet dust collector.

THE PURMA CAMERA HAS AN AMERICAN DISTRIBUTOR. J. L. Galef, 75 Chambers Street, New York City, in the summer issue of a wholesale catalog illustrates this British-made plastic camera and describes its operation and specifications in detail. Designed by Raymond Loewy, the Purma is unique in lightness, line and speed and it is priced much below the market level for good candid cameras.

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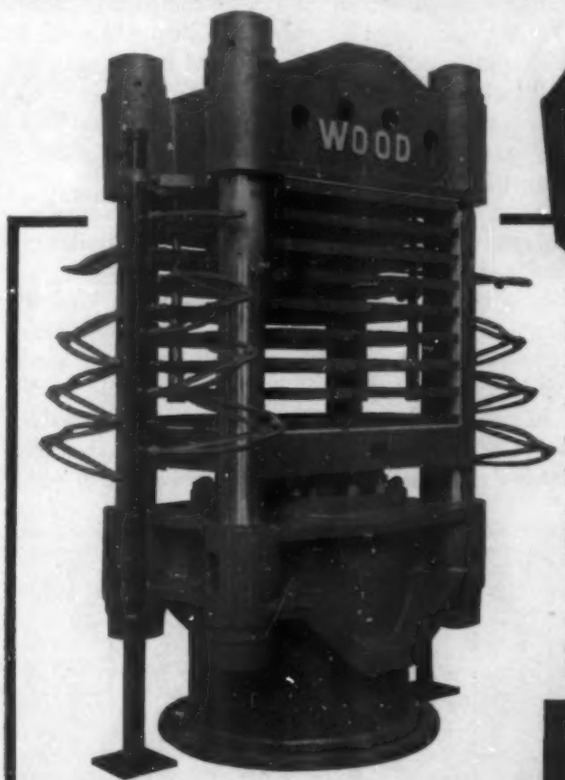

(Above) An 8-opening steam platen press operating on 2000 lbs. per sq. inch working pressure. Platen size—40" x 40".

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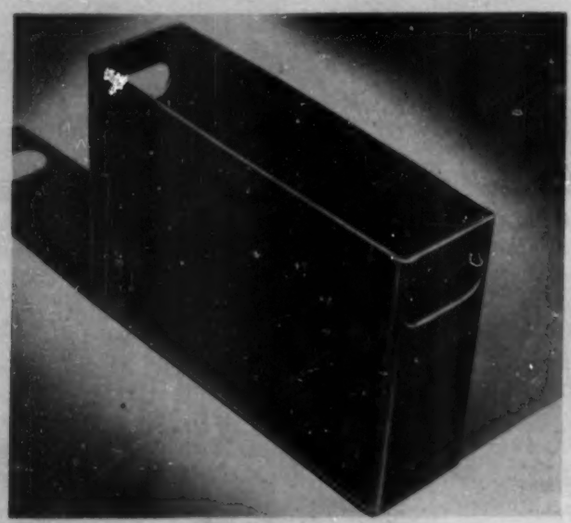
LAMINATED CONVEYOR BOXES

by DANIEL E. SULLIVAN*

A VERTICAL ENDLESS CHAIN TYPE OF CORRESpondence conveyor system to transport insurance policies and files quickly and economically from one floor to another is installed in the Metropolitan Life Insurance Company at One Madison Avenue, New York City. The policies are placed in boxes while making their journey from one floor to another and the conveyor is so arranged that the boxes can be slid on or off easily through a slightly inclined chute.

When the conveyor system was being planned, consideration was given to the type of boxes desired and the nature of the materials used since they would obviously be required to withstand severe service and constant handling. The desired qualities were summed up as follows: strength, reasonable lightness, resilience, resistance to wear and freedom from warpage. Metal boxes were not thought suitable because they would be too



Micarta conveyor box, after five years of service, shows relatively little wear

heavy if made sufficiently strong or subject to bending if made sufficiently light. Also, the necessary handling of metal boxes would create objectionable noise. Hard rubber boxes would have the disadvantage of being too brittle and hence subject to breakage if made rigid enough to be satisfactory. Wooden boxes were more acceptable than metal or hard rubber, but would have the disadvantage of being susceptible to warpage, possibly to an extent where they might bend when slid onto the conveyor rack, the latter being designed to afford a snug fit. Wooden boxes would have to be replaced occasionally owing to gradual deterioration or breakage.

The investigation which was carried on finally led to a consideration of a laminated phenolic product. It incorporated all of the major qualities desired for the boxes, being one-half as heavy as aluminum, extremely strong, resilient and yet not too flexible, moisture-proof, warpproof and highly resistant to wear. Tests were made which gave satisfactory results and final details were worked out. A plain rectangular box was chosen outside dimensions adopted being $14^1/_2$ in. in length by 6 in. in width by $10^3/_8$ in. in height. It was found that wall thickness of but $^3/_{16}$ in. would be sufficient. Black was chosen as the most practical color. Single piece construction was desirable, which meant the building of a special mold. A combination of paper base and fabric base was developed after some experimental work, the paper base being used as core material while the fabric base was used on the surface, giving added strength at the corners and more resistance to surface wear.

*Industrial Division, Westinghouse Electric & Manufacturing Company

IMPACT TESTING OF PLASTICS

(*Continued from page 41*) ties far too complicated for evaluation by any single test, however well conceived or skillfully manipulated.

Table 3 illustrates the lack of relation between the results of any single impact test on standard test specimens of four phenolic materials and results of tests on the completed apparatus fabricated of the same materials. These materials may be described briefly as follows: material A is a moderately high impact grade combining a relatively soft resin with a high cotton filler whereas material B is a stiffer resin with about one-third the flock content of material A. Material C is similar to A except of a somewhat differently processed compound. Material D is a material of all woodflour filler. In several types of apparatus tests, materials A and B have similar strengths whereas there is a substantial difference in their notched Izod values. On the other hand, material D is notably weaker in the apparatus tests and correspondingly weak in the notched Izod strength.

Going to a comparison of material A and material C we find that these two materials are somewhat similar in notched Izod but dissimilar in apparatus strength.

Study of the data reveals discrepancies of one kind or another in any attempt to relate any single test on bars to apparatus strength. The increasing blow test, used widely in Europe, appears to offer no measurable advantage either with or without notch over the single-blow notched bar test, and of course the unnotched results show the same wide spread of values which nor-

TABLE 4. STRENGTH RELATIONS OF THREE COMMERCIAL THERMOPLASTICS

Material	Standard A. S. T. M. Notched-Bar Izod, ft-lb.	Unnotched-Bar Izod (See Table III), ft-lb.	Increasing Blow Notched-Bar Izod, in-lb	Increasing Blow Unnotched-Bar Izod, in-lb.	Unnotched-Bar Charpy, ft-lb.	Flexural Strength, lb. per sq in.	Modulus of Elasticity, lb. per sq in.
A	0.144	0.509	1.10	5.75	0.634	6,400	487,000
B	0.342	0.917	2.20	8.86	1.292	5,900	271,500
C	0.125	1.720	1.00	16.6	2.523	13,850	....

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mally occur when using this type of specimen. The increasing blow unnotched Izod, for example, shows material D to be strong whereas all apparatus tests and field data show it to be relatively weak. Both Charpy and Izod unnotched indicate a considerable difference between materials A and B which is not shown by apparatus tests.

No apparatus strength test results are available for the thermoplastics. Table 4 gives the strength relations of three commercial thermoplastics as indicated by various tests on $^1/_2$ by $^1/_2$-in. bars. Thermoplastic A is a compression molding cellulose acetate, thermoplastic B is an extrusion molding cellulose acetate, and thermoplastic C is methacrylate resin. The relative strengths of the acetates are shown to be the same by any of the impact tests. In the flexural test, while the ultimate strength is of the same order, the relative stiffness, as indicated by the modulus values, is approximately in inverse ratio to the impact values. No such consistency is shown when comparing acetates and methacrylate. Although the notched Izod value of these particular methacrylate specimens is low, the unnotched values are unusually high. Which of these tests is of greater significance can only be determined by laboratory and field experience with the molded product.

Significance of a group of tests

It is apparent from the above data that the impact breakage of plastic parts of all materials is far too complex a problem for solution by any single impact strength test. The data indicate, however, that at least one, and possibly more, combinations of tests can be depended upon to predict apparatus strength.

Under certain limiting circumstances, as already shown, a single test such as the notched Izod, or a combination of two tests would probably suffice. For broad applications, however, it appears that a combination of three strength tests on test bars will satisfactorily predict resistance to impact breakage of molded parts.

In choosing such a combination one is naturally governed by two considerations, namely, engineering sufficiency and economy. From these viewpoints, the choice becomes reduced to some combinations involving the notched and unnotched Izod, the Charpy, and flexural strength.

Since the present authors have some preference for the Izod over the Charpy, a combination of notched-bar Izod, unnotched-bar Izod, and flexural strength was tentatively chosen. Data covering about 25 batches of commercial phenolics from two sources show that in every case where all three tests on test bars gave high values, the apparatus molded from the same material was of high strength. Likewise in every case where one or more tests gave low values the product was relatively weak. The data are given in Table 5.

In compiling the data for Table 5 extremely careful control of molding conditions was exercised so that the molded product was truly representative of the raw material. The data in Table 6 illustrate the importance of the close control. In the latter case the material used

Table 5. Relation Between Notched-Bar Izod, Unnotched-Bar Izod, Flexural Strength, and Apparatus Molded from the Same Material

Materials represent commercial phenolics from two sources.

For convenience in analyzing the following data, a "good" material was considered to have a flexural strength of 10,000 lb. per sq. in., a notched-bar Izod strength of 0.150 ft.-lb., and an unnotched-bar Izod strength of 0.675 ft.-lb.

Material	Flexural Strength, lb. per sq. in.	Notched-Bar Izod, ft-lb.	Unnotched-Bar Izod, ft-lb	Strength of Telephone Apparatus as Determined by Height of Fall Necessary to Break, in.
1	Condition (A)	All three tests good		
	11,900	0.189	0.735	65
2	Condition (B)	1 test poor		
	10,930	0.150	0.662	53
3	Condition (C)	2 tests poor		
	9,900	0.235	0.584	45
4	Condition (D)	3 tests poor		
	9,700	0.140	0.619	30

Table 6. Showing the Necessity for Molding Control in Attempting to Correlate the Mechanical Strength Tests on Test Specimens With Strength of Molded Telephone Apparatus

Material	Flexural Strength, lb. per sq. in.	Notched-Bar Izod, ft-lb.	Unnotched-Bar Izod, ft-lb.	Strength of Telephone Apparatus as Determined by Height of Fall Necessary to Break, in.
1	11,100	0.153	0.662	40.8
2	10,830	0.166	0.649	36.2
3	10,950	0.159	0.727	45.2
4	11,320	0.164	0.704	43.2
5	10,660	0.157	0.707	51.0
6	10,930	0.150	0.662	53.3
7	11,550	0.156	0.692	41.3
8	11,310	0.159	0.714	42.0
9	11,230	0.159	0.659	45.5
10	9,790	0.152	0.703	44.0

consisted of 10 batches of a particular commercial phenolic compound, and the molding conditions were allowed to vary through the widest commercial limits. In spite of the fact that the impact tests on the raw material indicate a reasonably consistent material, the strength of the molded product is highly variable.

Variation in results

In Table 7 are shown data on phenol plastic, urea plastic, and cellulose acetate when tested in various ways. It will be noted that the phenols are most consistent, the ureas next, and the acetates poorest. This wide variability in test results on acetate is quite obviously independent of test methods. A background of testing this material for some ten years has created the impression

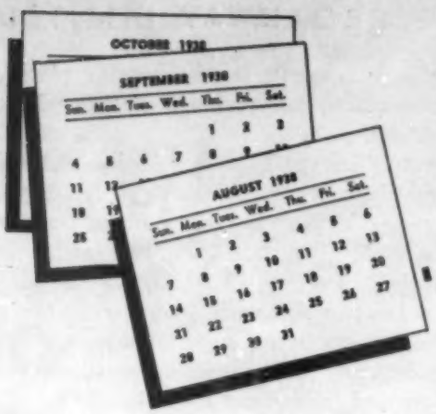

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TABLE 7.—SHOWING THE SPREAD IN TEST RESULTS OF A PHENOL PLASTIC UREA PLASTIC, AND CELLULOSE ACETATE COMPOUND TESTED IN VARIOUS WAYS

	Standard A.S.T.M. Flexural Strength Test, lb. per sq. in.[a]	Standard A.S.T.M. Notched Izod Strength Test, ft-lb.[b]	Unnotched Izod Impact Strength Test, ft-lb.[c]
Phenol Plastic	10,670	0.186	0.633
	10,990	0.188	0.651
	11,250	0.189	0.656
	11,280	0.191	0.661
	11,290	0.193	0.674
		0.193	0.691
		0.194	0.692
		0.195	0.697
		0.198	0.709
		0.199	0.732
Urea Plastic	9,450	0.145	0.565
	9,580	0.149	0.621
	12,750	0.154	0.625
	12,870	0.158	0.630
	13,030	0.160	0.661
		0.164	0.677
		0.164	0.714
		0.168	0.719
		0.175	0.727
		0.178	0.748
Cellulose Acetate	3,780	0.156	0.292
	4,000	0.168	0.307
	7,810	0.171	0.343
	8,190	0.172	0.441
	8,230	0.173	0.483
		0.182	0.529
		0.186	0.652
		0.189	0.700
		0.203	0.746
		0.208	0.922

a Five bars molded from same material.
b Ten bars molded from same material.
c Ten bars molded from same material. (Standard A.S.T.M. bar, except unnotched.)

among us that the general physical characteristics, including some properties not within the scope of this paper such as cold flow and "unmolding" (reverting to granular form), are substantially influenced by factors which are unknown, at least for the present.

Standard methods of test

The standard methods of test for resistance to impact and flexural strength (Methods D 48–37)[8] were used throughout this investigation except as follows:

In measuring the flexural strength of soft thermoplastics where the specimen did not break, the maximum load was taken as the failure point.

For the increasing blow notched and unnotched Izod tests a $^1/_2$ ft-lb. machine was used except in the case of the high-strength materials where the standard 2 ft-lb. machine was used with some modifications of the hammer to permit striking a blow of approximately 1 ft-lb.

[8] Standard Methods of Testing Molded Materials Used for Electrical Insulation (D 48-37), 1937 Supplement to Book of A. S. T. M. Standards, p. 232.

THE NEW BROADWAY LIMITED

(*Continued from page 29*) seats are comfortably placed. Lighting fixtures, placed for maximum efficiency have urea diffusing shades.

In the Observation Lounge (Figs. 4–5–6) glass enclosed luxury replaces the old-time observation platform. Built-in sofas and club chairs face outward for true enjoyment of the passing scenes. Cork and leather in natural colors are used for wall coverings, while deep pile carpeting and interesting textured fabrics lend themselves to the decorative scheme. Laminated plastic tops are used on the desk and tables, and window sills of the same material are used throughout the train.

Sleeping rooms have been completely redesigned for greater comfort and convenience. Master Bedrooms with four comfortable roomy folding arm chairs create a luxurious living apartment en route. At night there are two full length folding beds which disappear into the wall during the day. Drawing Rooms are entirely new as are Compartments, Double Bedrooms and Roomettes.

"We hope," said Mr. Loewy, "that this train will make people realize that railroads are really on the alert in their search for service to travelers. It certainly will refute the impression so often expressed, that railroads are slipping as a modern means of transportation.

The transparent rods used in the back-bar are Lucite while the laminated materials are Formica. The train is air conditioned throughout.

FINESSING A MARKET

(*Continued from page 25*)

Quite frequently, developments in plastics are announced to industry. Rarely, however, are we told the interesting stories behind these accomplishments. We are seldom told the story of years of heartbreaking research culminating in the finished application we read about. Nor are we acquainted with the practically overnight blossoming of other ideas. The molded-laminated standard model Autobridge is one of those developments necessitated by a specific need. A need which required speedy and effective results.

At the inception of this article a plan was set forth outlining the necessity for two distinct models. The first was the all-molded de luxe board already discussed; the second, the standard model which must in no way be mechanically inferior to the other and must possess quite definitely, design appeal conducive to quantity sales—all at an appreciably lower cost.

Of course, an all molded design would not fill these requirements. A combination punched paper base phenolic laminated top and a molded base were considered but were also found unsatisfactory, on a cost basis, even though the laminated top would reduce the cost.

For a number of years molded-laminated materials have been advocated by alert members of the plastics industry. The idea, however, had seldom progressed be-

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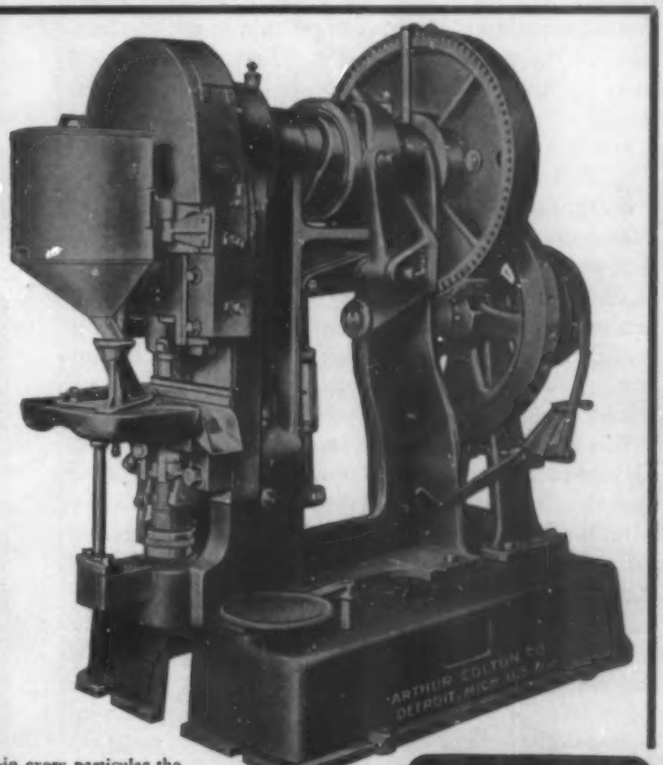

Colton Preforming Machines are the accepted standard in the plastics industry not only because they speed up the molding cycle but because their unvarying accuracy of performance is a guarantee of better molding at the press. When Colton preform-pellets are used material waste is eliminated, flash is held to the ideal minimum, material handling problems are simplified and costs d
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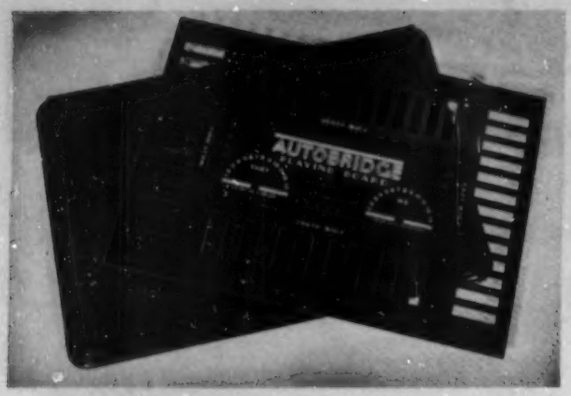
COLTON DETROIT



The base of the Autobridge board is molded to shape using Textolite impregnated laminating paper. The top panel is carefully punched from fabricated sheet stock of the same material

yond the discussion stage. The possibility of adopting this plastic technique to the Autobridge base has changed these discussions into realities.

Laminated phenolic materials are, for certain applications, better suited and much lower in cost than molded phenolics. Hence, it could be concluded that a molded-laminated product, if properly designed, would also be less expensive than straight laminated and yet possess a fine surface finish.

A base design was prepared to include all precautions which could possibly be thought of. Paper base phenolic laminated materials cannot flow to shape, as the molding of these materials is essentially a displacement process. The part had to be designed so that, in the process of molding, the least impedance to the displacement of the stock would result. This meant that no sharp corners could be tolerated and large radii were essential. Taking into consideration that modern design is based, in the main, on this principle, the preparation of a suitable design for the base was not too difficult.

A fabricated laminated top was decided upon. This offered only the problem of designing a punching die that would pierce all the slots and holes (62) in the top, in one operation and definitely assure accuracy. With this accomplished the next step was to find a suitable method for applying the required marking on the surface. Another recent development was utilized—the application of metallic leaf by the roll-leaf process.

This method of marking plastics is particularly well adapted to applications on laminated stock because of the smooth surface finish and because of the fact that the material is resilient and will "give" if any surface irregularities occur. The combination of "fine line" letters and the bright silver leaf creates an effect on the finished job which would be hard to surpass.

Molded slides could not be used on this standard model because of the depression required on the under side of the top to suitably utilize a molded type of slide. A molded top would have to be used, which again would make the cost out of line. A satisfactory metal slide was developed, which, because of the smooth surface of the laminated board, and the regularity of the punched slots, operated extremely well.

A metal hinge fastened to both the top and the base by spun-over tubular rivets created a neat and substantial assembly. All this plastic engineering, designing and development has resulted in a more salable piece of merchandise for Autobridge, Inc., one which has the appearance of quality and a far longer useful life than the playing board it replaced.

THE BEGINNING—OR THE END?

(*Continued from page 23*) of equal amounts of material in each chamber played important parts in securing uniform flow into the cavity and elimination of weld marks.

During the development of the specifications for this larger type equipment, it was found that many ideas or theories were prevalent regarding mold clamping pressures required. These theories varied from 5 to 12 tons per square inch of projected cavity area. Whereas 900 tons of clamp was about the minimum recommended for a steering wheel of conventional design, that is, with the rim, spokes and hub covered with material, it was decided that 600 tons should be sufficient for the newer banjo design wheels. In this type, the rim only, including a short material boss on the spoke ends, was molded. This determined the clamping pressure adopted for the larger machine.

Material pressures as recommended were more uniform; consequently, it was decided to incorporate three different size rams on the platen operating the three extrusion cylinders. These rams were concentric and 6 in., 8⅝ in. and 10½ in. in diameter, respectively. This design yielded material pressures varying from 10 to 70 tons and piston speeds (empty) of 250 in., 119 in. and

Fog lamp shell with 52 sq. in. projected area, 78 sq. in. surface cavity area (both halves), which weighs 8 ⅝ oz. Produced experimentally

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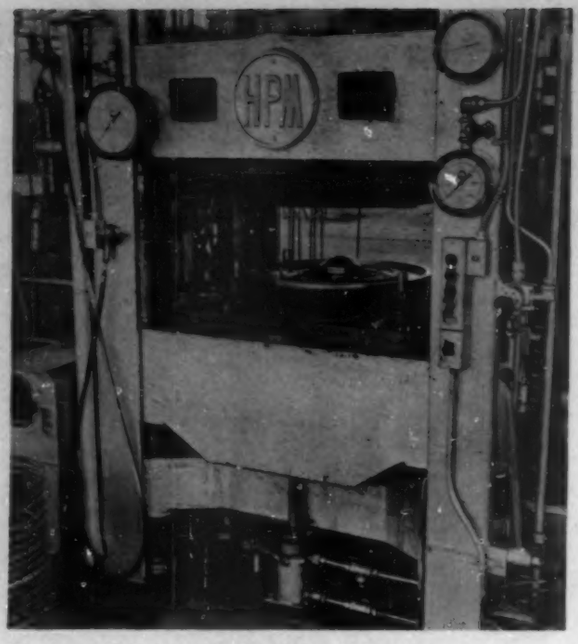
81.4 in. per minute, respectively. The preheating tunnels were designed about 26 in. long, $2^1/_4$ in. in diameter at the large end and $1^1/_8$ in. in diameter at the small end. No torpedoes or pineapples were originally incorporated, but it was soon discovered that granular materials were being forced into the injection cylinders and thence into the mold cavities without being properly heated. Inasmuch as cellulose acetates are such poor conductors of heat apparently a tube of 1 in. diameter heated to 400° Fahrenheit would never plasticize the material throughout, regardless of its length or the speed with which the materials were forced through it. To improve this situation, small torpedoes reducing the thicknesses of the materials to approximately $^3/_{16}$ in. were incorporated at the small ends of the preheating tunnels. Although this revision slowed down the piston speed in the preheaters, the resultant materials were properly and thoroughly heated for molding.

Any one or two of these preheaters can be disconnected and it is possible to assemble two preheating tunnels onto a single injection cylinder if desirable. This represents a flexible hook-up for custom work, as the machine can be revised to inject 6 to 12 ounces for one cylinder, or 18 ounces for all three. In case shorter cycles are desired on a piece six ounces in weight, the three cylinders can be utilized and at least three shots per minute secured. The machine itself is capable of plasticizing 68 lbs. of material per hour which can be distributed over any cycle of operation down to three shots per minute. The completed machine weighs approximately 66,000 lbs. and is 21 ft., 7 in. in height overall.

For steering wheel purposes, three gates are incorporated, one from each injection cylinder directly into the rim at right angles and at equal distances apart, midway between the three spokes. These gates are approximately 1 in. wide by $^1/_8$ in. thick. Tubular rim reinforcements were used originally, but it was soon found that the material injection pressures were sufficiently great to collapse any size tubing; consequently, solid steel rod was substituted. Material pressures also had a tendency to displace the rim reinforcement in an up and down direction. To overcome this difficulty, the gates were so placed in the die that the material always forced the rim reinforcement upward. Three pins were then inserted, $^1/_8$ in. in diameter, in the upper cavity of the mold the same length as the material thickness. These pins with the mold clamping the wheel spokes at the rim end securely held the reinforcements in proper position for molding.

At present a production cycle of less than one minute can be maintained and due to the fact that the molded wheels require very few finishing operations, we predict that it will not be long before all steering wheels of acetate or other thermoplastic materials will be fabricated by injection. In plain colored acetates, all material weld marks are eliminated and an exceptionally fine finish is obtainable if proper pressures are used together with the necessary material and mold temperatures.

The experimental work on larger parts such as steering wheels, lamp shells, instrument panels, radiator grilles,



Close-up of steering wheel mold with three gates through which the cavity is filled

and automotive garnish moldings proves that general injection principles may be used. However, multiple heating chambers are desirable because they make it possible to use shorter gates to the cavity at different points permitting rapid filling of the cavity, thereby reducing the possibility of weld marks; and most important of all, less variation is required in mold temperature during the complete cycle. Individually controlled heating chambers are also desirable, as it is then possible to vary the temperature and quantity of the injected material for each cylinder, which enables the operator to compensate for any localized variation in die temperature. Such a condition might be caused by the particular die construction or design and the location of the water lines in relation to the cavity as well as outside influences. Thin sections are of course preferable for two reasons: Economy in material and faster cooling in the die, resulting in shorter production cycles. The difficulties involved in thin sections on large moldings lie in completely filling the cavities and welding the material before it chills. Piston speeds on the injection chambers are, therefore, highly important. The quicker the mold can be completely filled the better. However, such speed must necessarily be balanced off with proper clamping pressures on the dies as well as possibly some venting to permit the rapid escape of gas and expanding air in the cavity. No set rules can as yet be formulated as each piece to be molded demands different requirements for satisfactory work. After two years of experimental injection effort, we are ready to fabricate any large parts taking advantage of the same economies applicable to smaller pieces. Archimedes said, "Give me a lever long enough, a place to rest it, and I will lift the world." We conclude, "Give us equipment large enough, a place to rest it, and we will inject the world." Of course, we would want to do it in two parts with thin, uniform wall sections.

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STRUCTURAL MATERIAL FOR AIRCRAFT

(*Continued from page 36*) in the use of thicker walls of lighter materials, in some cases even with a somewhat smaller modulus-density ratio."

Static strength

The comparative tensile and compressive strengths and ratios of strength to specific gravity of the aircraft materials and plastics are shown in Table 2. Although the values for the strength of the plastics are less than for steel and aluminum alloy, they are equal to or greater than for spruce which is used for structural members of aircraft. The tensile strength-weight ratios of the ordinary laminated phenolic products (paper or fabric reinforcement) are less than those for steel, aluminum alloy and wood, but the phenolic products with cord or wood reinforcement compare favorably with these accepted constructional materials. The compressive strength-weight ratios of the plastics are of the same order as those of the metals.

Modulus of elasticity

In many cases the component members of an aircraft will fail by instability due to buckling before the material can develop its full strength in compression. In these instances the strength of the member will generally increase with an increase in the ratio of the modulus of elasticity to the specific gravity of the material, provided the outside dimensions of the member and its weight are unchanged. Average values for the modulus of elasticity in tension and compression and the moduli-density ratios are shown in Table 2.

The conventional types of laminated plastics are characterized by low moduli of elasticity, particularly in compression, and it was realized very early that this lack of stiffness is a major problem in the utilization of reinforced plastics for structural purposes. With reference to metals Tuckerman[9] notes that "Density and modulus of elasticity are stubborn properties of the material. The most violent differences in heat treatment and mechanical working, differences in treatment which change the strength of a material by ratios as great or even greater than 10 to 1 can, at most, cause a change of a few percent in either modulus or density." However, the stiffness of reinforced plastics can be varied over a wide range by differences in the type of reinforcement used and in the pressure applied in manufacturing the plastic. Cord reinforcement is much superior to paper or fabric filler if increased tensile strength and Young's modulus in tension are desired. On the other hand, wood veneer reinforcement gives higher values for the modulus of elasticity in compression than the other types of fillers investigated, and according to King[10] is much to be preferred for main structural members. However, according to the latter investigator, the more lightly loaded parts of aircraft structures do not require a material of great ultimate strength but rather one which is self-stabilized over large areas and capable of taking moderate loads without premature waving. He reports the development of a light composite sandwich material produced by binding resin-sprayed facings to a central low-density core (closed pore sponge rubber) which acts almost entirely as a means of support and so enables the skin to develop loads approximating to the ultimate strength of the material employed.

The usual reaction to the problem of increasing the stiffness of the plastics is the thought that metal mesh, rod or wire should provide a satisfactory reinforcing medium. It is rather surprising to find that data on the properties of such products are lacking. King[10] notes that "the proposal to use wire reinforcement near the top and bottom surfaces of beam members certainly deserves very careful consideration. If the designer is disposed to allow some additional weight in order to attain greater beam stiffness, the twin problems of slip and unequal expansion still remain to be solved. As regards the first of these, much depends on the size and rate at which the load builds up in the reinforcement by shear transference from the surrounding mass of resin. Other things being equal, greater strength would be obtained by the use of a large number of very thin reinforcing filaments rather than by using a few thick ones, for obviously the surface cross sectional area ratio would be greater and consequently a better shear linkage would be attained. The loosening of the bond between the resin and reinforcement, on account of unequal expansion, is a matter requiring some consideration. The coefficient of lineal expansion of synthetic resin is approximately four times that for steel, but supposing the former 'shrunk' onto the reinforcement, this difference of expansion may not be serious over the small temperature range which is likely to occur in practice." It has also been pointed out by Walker[11] that there is good reason for avoiding, if possible, metal reinforcement because its use would introduce into the material the poor fatigue properties of crystalline matter.

The moduli of elasticity of the various structural materials have been compared in Table 2 on the basis of their modulus-density ratios. De Bruyne[2] points out, however, that this is not an entirely satisfactory basis for the comparison of their relative suitability for various aircraft members, because stiffness involves constants characteristic not only of the material but also of the geometrical features of the structure. For example, in computations on the stiffness in stressed skin construction, it is not $\frac{E}{\text{Sp. gr.}}$ but rather the magnitude $\frac{\sqrt[3]{E}}{\text{Sp. gr.}}$ that is of chief significance. Thus, for many purposes a low density is more important than a high modulus of elasticity, which makes the comparison of the stiffnesses of the metals and reinforced plastics more favorable than would be apparent from Table 2.

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9. L. B. Tuckerman, Aircraft: Materials and Testing, Proceedings of the American Society for Testing Materials, Vol. 35, Part II, pp. 3–46, 1935.
10. See discussion of de Bruyne's paper by E. P. King in reference given in footnote 3.
11. See discussion of de Bruyne's paper by C. C. Walker in reference given in footnote 3.

To be concluded, Technical Section, September issue

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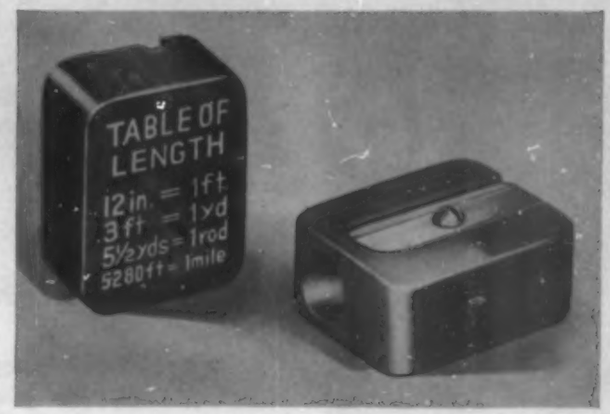

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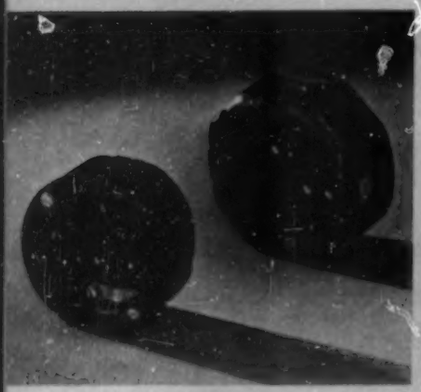

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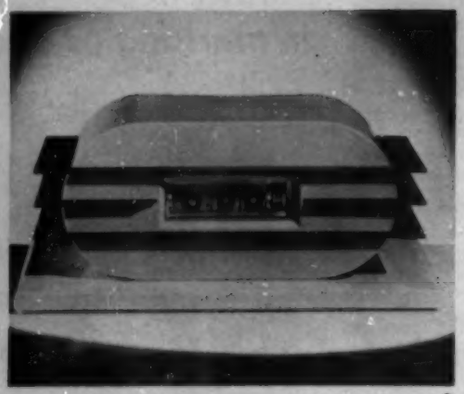

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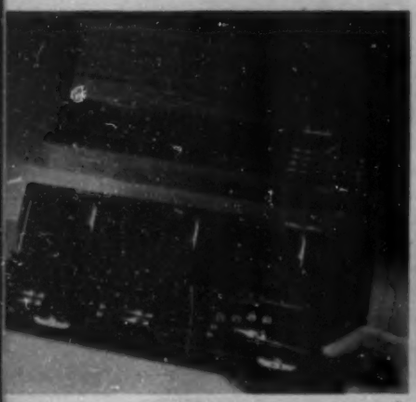

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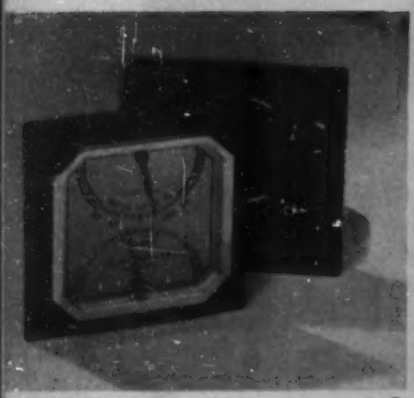

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1. Corrosion from ammonia fumes in cattle barns, and acid fumes in chemical or industrial plants does not attack these Parker outlet boxes which are housed in Bakelite and molded by the Union Insulating Co. They are 3 1/4 in. standard size and are recommended for use with non-metallic sheathed and CNX type cable wiring

2. Molded by Chicago Molded Products Corporation for the Penwood Company, this modern clock is housed in Plaskon and trimmed with strips of acetate in a contrasting color for decoration

3. The Wood-Regan Instrument Company has adopted plastics for their new, light-weight Lettering-Guide cabinets. They are produced of Bakelite molded by Auburn Button Works, Inc.

4. Zerbee Rotating Tooth-brush, operated by hand, is molded of Lumarith in six popular bathroom colors; blue, green, rose, orchid, black and white. Molded by Insulation Manufacturing Company

5. Recent model in the Taylor Instrument Company's line of Humidiguides, is this small one with a Durez case which is being offered for advertising or premiums. Advertiser's name may be imprinted on the dial

6. Maximax razor blade sharpener molded of Plaskon by Midwest Molding and Manufacturing Company for Maximax, Inc., is light-weight and easy to use

7. The Palmetto Brush and Whisk Company manufactures these whisk brooms which feature Bakelite molded handles in a large variety of colors to match other accessories. Molded by A. L. Hyde

8. Willoughby Baker Studio is molding this NoMorDust item for Gadgets, Inc. It collects dust from vacuum cleaners without spilling. The molded Durez collar is fastened to the wire standard by set screws

Manufacturers' addresses will be sent if you will write to the Editor, enclosing 3-cent stamp for reply

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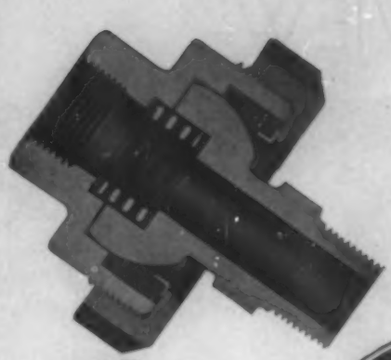

Swivel 7AS-8CS

Swivel 7AS-8BS

BARCO SWIVEL JOINTS

● Don't take chances on expensive shutdowns and production delays. Where pipe movement is involved, depend on BARCO joints to solve your problem.

Swivel 7S-8BS

BARCO MANUFACTURING COMPANY

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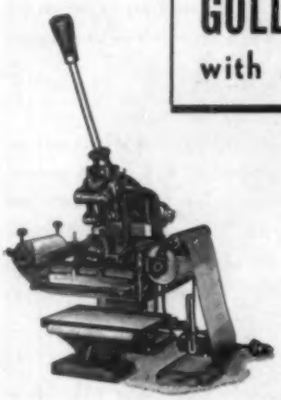
GOLD INLAYING PRESS

with Automatic Roll Feed



- Positive feed ¼" to 5½"
- Takes Roll Leaf any width to 5".
- Setups and adjustments quickly made.
- Stroke gives ample clearance to feed in work.
- Made in 3 sizes. Furnished complete with electrical equipment.
- Also furnished without roll feed, for use on light pressing and swedging.

SPECIALISTS IN

INJECTION MOLDS

DESIGNERS & BUILDERS

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EASTERN REPRESENTATIVES FOR LESTER INJECTION MOLDING MACHINES

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STANDARD TOOL COMPANY

73-75 Water Street, Leominster, Mass., U. S. A.

Send for Catalog "F"

100% PLASTICS

Not only the housing, but the entire operating mechanism of this salt tablet dispenser, is molded of plastic materials. The result is a handsome, rugged, non-corrosive device, which performs perfectly, even under hard industrial service.

The need for protecting contents against moisture calls for extreme accuracy, both in molding and in finishing. A Chicago Molded job, of course, produced for Fairway Laboratories, Inc., of Saint Louis.

Our booklet, "The Story of Plastic Molding," contains valuable information for any firm using, or contemplating the use of plastic molded parts. A copy is yours for the asking.

CHICAGO MOLDED PRODUCTS CORPORATION

2146 Walnut Street — Chicago, Ill.

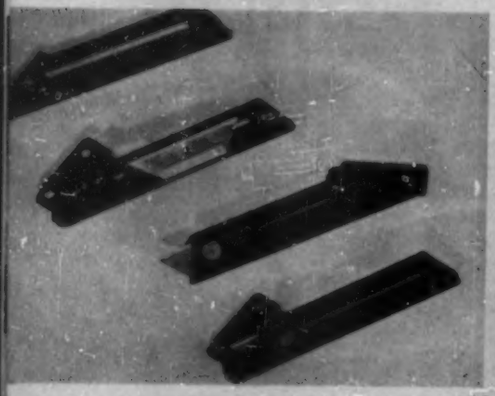
IN REVIEW

9

10

9. In this new Lumarith Electro-Static clothes brush, the ordinary bristles have been replaced by molded grooved sections. It is manufactured by the Sewell Manufacturing Company

10. Tinnerman Stove and Range Company recently announced a new combination gas-electric range with a built-in electric cooker and "pop-out" valve control. Trim strips of Bakelite and Plaskon in black, red, green and blue give pleasing contrast to the white enamel



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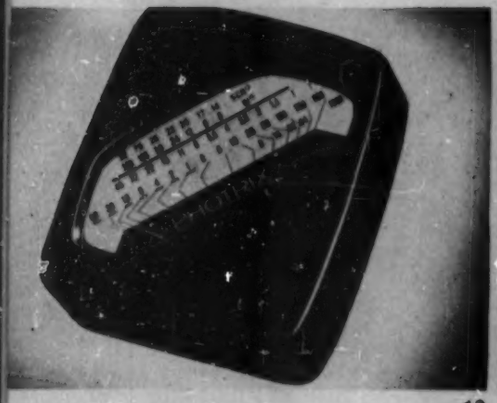
12

11. The Tu-Way Cutter is especially adaptable for use in opening heavy cardboard containers with a straight, quick cut. Molded of Resinox for the Morskil Company

12. Sanitary Toilet Seat, manufactured by the Sperzel Modern Seat Company, is molded of Bakelite by Chicago Molded Products Corporation



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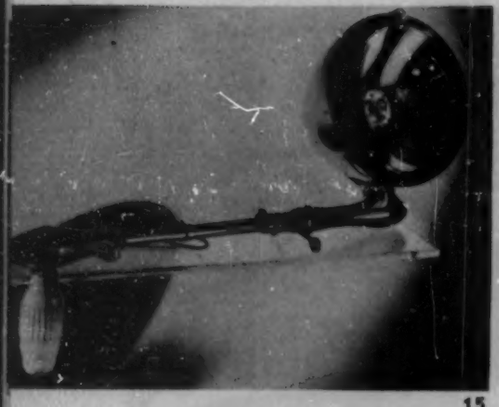
13. Photrix, a new photo-electric exposure meter, distributed by Intercontinental Marketing Corporation, is housed in a Bakelite case. It may be conveniently worn on the wrist, leaving both hands free to operate the camera

14. A new use of plastic materials is introduced on the counters of the latest petroleum metering equipment manufactured by Ralph N. Brodie Co. The Brodimatic Meter features an acetate counter case and transparent dial covering, both of Tenite



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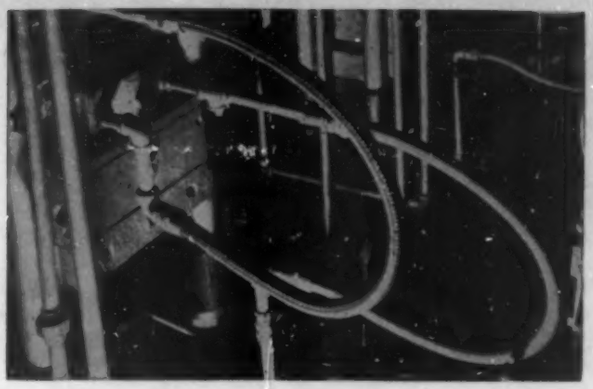
15. Appleton Electric Company manufactures this automobile spotlight, which features a Plaskon handle

16. Complete safety and protection are afforded the operator and patron through the use of the Duart Manufacturing Company's new plastic hair wave machine, parts of which are molded of Durez by Remler Co., Ltd., and Universal Molding Co.

Manufacturers' addresses will be sent if you will write to the Editor, enclosing 3-cent stamp for reply

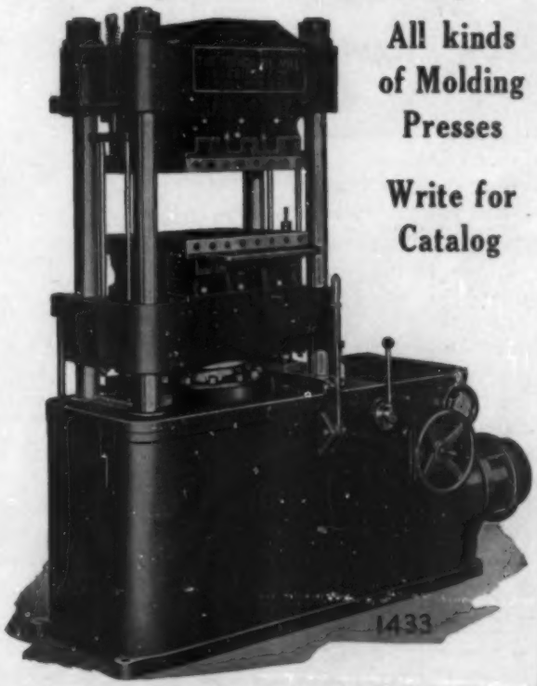
REX-WELD flexible metal hose



Developed for platen presses, REX-WELD flexible metal steam connections insure constant tightness under alternate heat and cold. Exclusive one-piece construction—no packing, no leaking, no tightening. Use with Rex-Tite detachable metal-to-metal seat couplings for maximum service at minimum cost. Write for data.

CHICAGO METAL HOSE CORPORATION
(Formerly Chicago Tubing & Braiding Co.—Established 1902)
MAYWOOD, ILLINOIS (Chicago Suburb)

French Hydraulic Machinery



All kinds of Molding Presses

Write for Catalog

Self-Contained Molding Press, Patent Pending

***The* French Oil Mill Machinery Co.**
Piqua, Ohio

because color

IS A FACTOR

Temperature is vitally important in plastic molding. Keeping within tolerance limits specified by the powder maker, calls for constant checking and rechecking of mold temperatures. The Cambridge Mold Pyrometer immediately detects off-temperature cavities. It thus insures not only uniform color, but accuracy as to form and texture as well. Quick, convenient, rugged . . . a Cambridge is the instrument powder makers recommend for use in the Plastic Plant.

Cambridge Instrument Co., Inc.
3732 Grand Central Terminal
New York City

CAMBRIDGE
Mold • Surface • Needle
PYROMETERS

Send for details of these instruments. They will help save money and make better plastics.

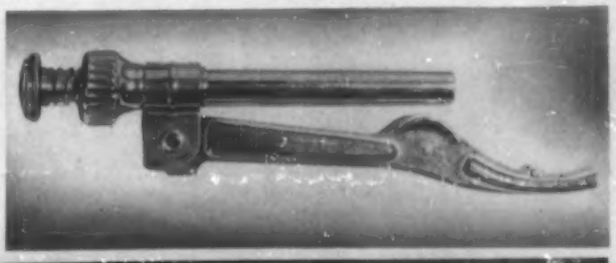
HOW TO SELL A HIGHER PRICED *HAIR CURLER* . . . Or Whatever Your Product May Be!!

The Presto-Matic Bob Pin Hair Curler is a better hair curler. But that isn't enough. Its superiority has to be dramatized. It has to *look* better.

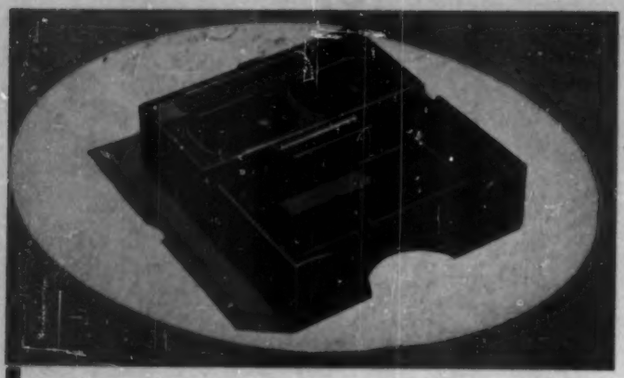
So the Presto-Matic curler sports this attractive AICO injection-molded button-plunger added at negligible cost. It adds a dash of color and style (a mine of feminine appeal) . . . meanwhile performing an integral operation of the product's use.

Perhaps your product too is bothered with lower priced competition. The chances are a gem-like plastic part (or the *whole* product in plastics) could elevate it over all others in appeal . . . and hoist sales!

Let one of our representatives go over this matter with you. We are long experienced in such merchandising.



AMERICAN INSULATOR CORP.
NEW FREEDOM, PENN.



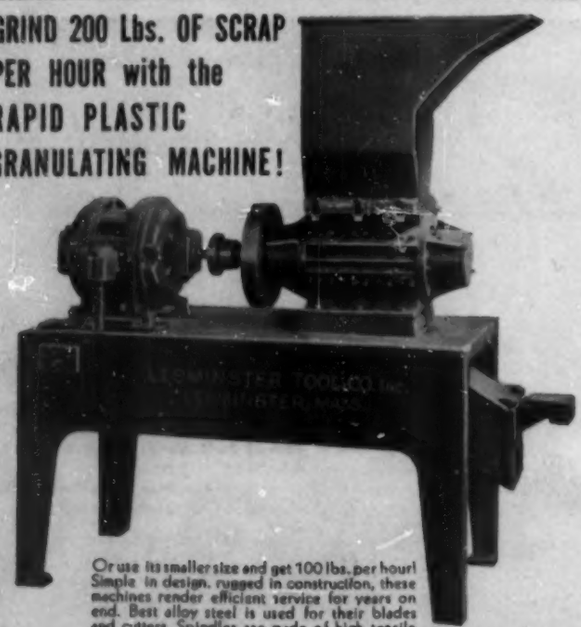
a Reminder to Call in K & J

This desk accessory, moulded for Alfred Robbins Organization, is a smart piece of reminder advertising—and just as smartly moulded by K & J craftsmen, who also, by the way, made the moulds. It's another example of K & J "straight-line" production which is effecting economies for the many companies with which we are working. We'd like to give you full details. Write us!

If you have a job for MOULDED THIOKOL, we're well equipped to handle it.

Kuhn & Jacob
MOULDING and TOOL CO.
1203 Southard St., Trenton, N. J.
New York Office, PEnn 6-0346 Phila. Office, HANcock 0972

GRIND 200 Lbs. OF SCRAP PER HOUR with the RAPID PLASTIC GRANULATING MACHINE!



Or use its smaller size and get 100 lbs. per hour! Simple in design, rugged in construction, these machines render efficient service for years on end. Best alloy steel is used for their blades and cutters. Spindles are made of high tensile alloy steel, hardened and ground, and mounted on Timken Roller Bearings.

Each machine comes with two different sized screens, 3/8" and 1/4", interchangeable in two minutes . . . . and with underneath chute to carry granulated plastic to basket.

Investigate these money-saving machines now. Write for folder and full information.

LEOMINSTER TOOL CO., Inc.
272 Whitney St. Leominster, Mass.
Mfrs. of complete line of equipment for Catalin, Celluloid and Plastic Molding AND EXTRUSION MOLDING DIES.

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BRESKIN & CHARLTON PUBLISHING CORP.
425 FOURTH AVENUE, NEW YORK CITY

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The Clean Buffing Compound

LEAROK has no "free grease" in it. It is clean. It doesn't get into crevices and ornamentations. This, coupled with its excellent buffing properties, make it ideal for finishing plastics. LEAROK can be obtained tinted to match the color of the finished article.

Send a sample of your work for our recommendations.

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Waterbury, Conn.

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656 Notre Dame St. West, Montreal, Canada

With an eye to beauty, Lovell Manufacturing Company, world's largest manufacturer of Pressure Cleaners, switched to plastic control handles.

With an eye to economy, they turned to Erie molding engineers who adapted the design to the many advantages of high production, low cost injection molding.

Perhaps your product can be dressed up and made cheaper, too, by using this newest type of molding. Let the Erie design department show you what can be done. There's no obligation. The only limitation is that the projected area must be less than 24 square inches. Send us a sample or prints.

*Your Product.

ERIE RESISTOR CORP. — PLASTICS DIVISION
640 W. 12TH ST., ERIE, PA.

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GREATER EASE AND FLEXIBILITY OF CONTROL

THE HIGHER THE PRESSURE THE TIGHTER THE VALVE

AUTOMATICALLY REGRINDS OWN SEALING SURFACES

LONG TROUBLE-FREE LIFE LOW MAINTENANCE

QUARTER CENTURY OF SUCCESSFUL USE

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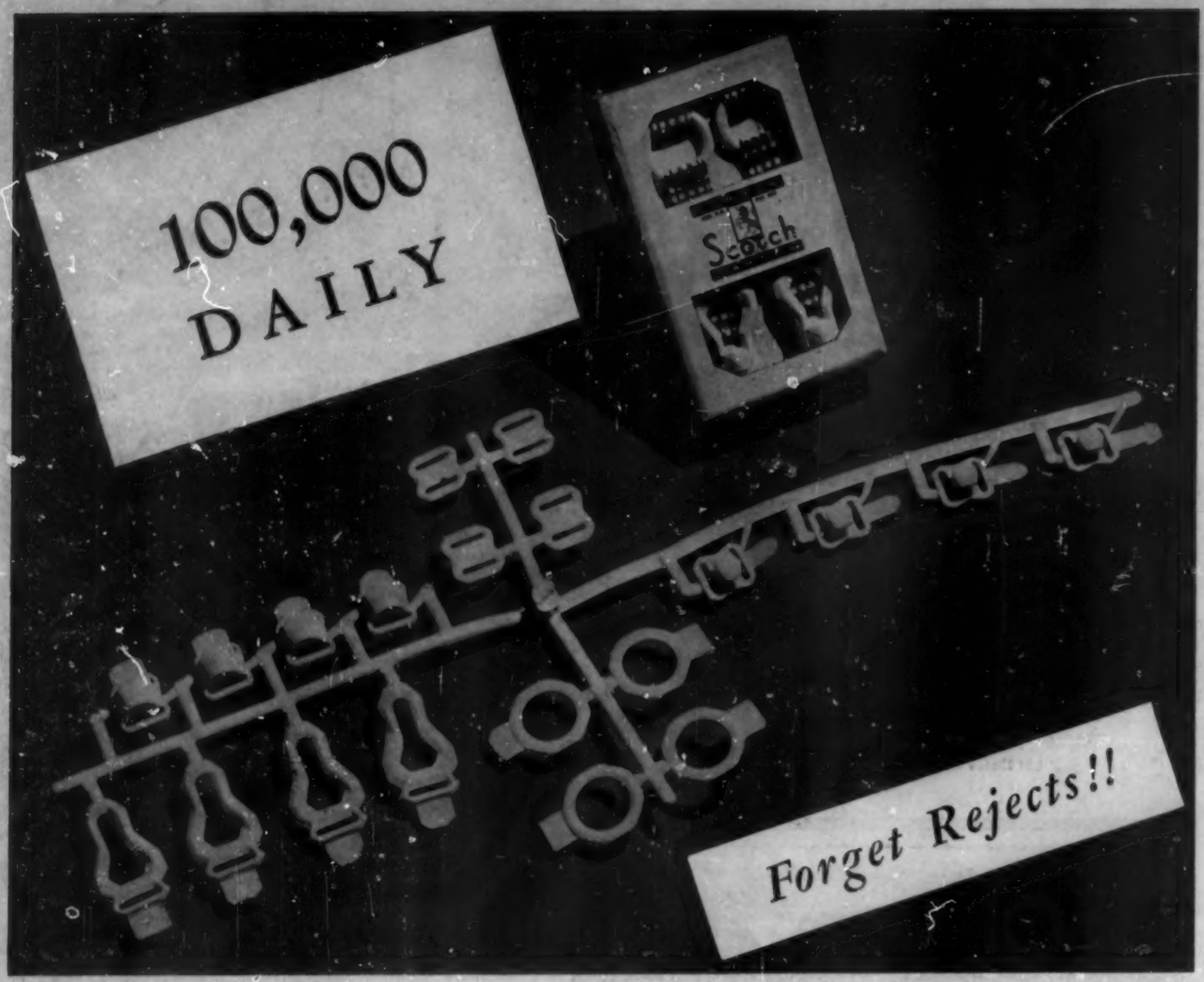

Rejects are a giant item in your molder's bill. So big, in fact, that most molders prefer not to talk about them.

So that when we point out that we are producing this splendid injection molding job, 100,000 daily—with rejects that are negligible—THAT'S NEWS, worthy of your careful consideration.

These parts are the fasteners, slides, loops, buttons and hooks for THE SCOTCH GARTERS of Condor Products, Inc., of Buffalo, N. Y. The casting measures from tip to tip a full 14 inches! An extraordinarily large 20 cavity mold is employed that produces 4 complete sets of parts each cycle—with some sections having a controlled thickness of but .008 inch. This is a patented feature of these garters which lowers assembly costs and greatly improves the finished product by eliminating bulk.

Fine as this job is, however, you will find it merely typical in quality and economy of dozens upon dozens of other NORRIS jobs. If you have a molding problem of any kind, Paul A. Norris Co. stands as an organization with the facilities, the experience and the ingenuity to get at the fastest and best solution.

The PAUL A. NORRIS Company

WELLSTON OHIO